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Higher-Order Ionospheric Effects on the GPS Reference Frame and GPS velocities

E.J. Petrie (1), M.A. King (1), P. Moore (1), and D.A. Lavallée (2)

(1) Newcastle University, School of Civil Engineering & Geosciences, Newcastle upon Tyne, NE1 7RU, United Kingdom (elizabeth.petrie@ncl.ac.uk), (2) Delft Institute of Earth Observation and Space Systems (DEOS), TU Delft, The Netherlands

We present time series over the period of a complete solar cycle (1995 - 2008) showing the influence of the second and third order ionospheric terms on the GPS reference frame. We include a comparison of the differences found when using either a tilted dipole model or the International Geomagnetic Reference Field (IGRF) for the magnetic field component of the second order term. We examine reference frame translation, rotation, and scale change and velocity effects. We find relatively small differences between the dipole and IGRF solutions, reaching their maximum at ionospheric maximum. For both approaches the reference frame effect is most significant in the Z-translation, where it varies from < 1mm at solar minimum up to 10-15mm at times of peak ionospheric activity. The impact on the other reference frame parameters is much less significant.

The mathematical formulation is as outlined in Fritsche et al. (2005). The GPS processing was performed using a modified version of the GAMIT software using a global network of stations, and includes recent developments such as improved tropospheric mapping functions and antenna phase centre corrections. The Total Electron Content (TEC) was obtained from IONEX files.

Finally, we present preliminary data showing the effects on the above of including a simple model of ionospheric bending of GPS signals, as suggested by Hoque & Jakowski(2008).