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Precession-nutation and the Earth's dynamical flattening

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The value for the Earth's dynamical flattening H has generally been derived from astronomical observations of precession-nutation, which are currently based on Very Long Baseline Interferometry (VLBI) determinations of celestial pole offsets. The most relevant quantities to be used for this purpose are the precession rates in longitude and obliquity, which are integration constants of the differential equations for the motion of the equator in the geocentric celestial reference system (GCRS). The precession rates can be expressed as functions of a number of contributions, including first order and second order effects in luni-solar torque, direct planetary torque effect, tide and J_2 variation effects, non-linear effects, and geodesic precession (Williams 1994, Mathews et al. 2002, Capitaine et al. 2003, Bourda & Capitaine 2004). These contributions are themselves dependent on various astronomical and geophysical parameters (e.g. obliquity at epoch, masses of the Moon, Earth and Sun, J_2 time variation, etc.). The value for H is therefore dependent both on the observations on which the estimate is based and on the theoretical expressions for the various contributions to the precession rates and consequently on the adopted values for the relevant parameters. The determination of the Earth's dynamical flattening is especially dependent on the theoretical expression for the first order luni-solar term as function of H.

This paper will discuss the rigorous procedure to be used for deriving the Earth's dynamical flattening H from the best available astronomical observations and compare the most recent determinations. It will provide the correlations of this quantity with other parameters, as well as the limit that can be reached for its accuracy, given the characteristics of the available observations and the uncertainties in the models and parameters on which H is dependent.