The variation of UT from 700 BC to the present

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Abstract

Records of solar and lunar eclipses in the period 700 BC to AD 1600 originating from the ancient and medieval civilisations of Babylon, China, Europe and the Arab world are amassed and critically appraised for their usefulness in answering questions about the long-term variability of the Earth's rate of rotation. Results from previous analyses of lunar occultations in the period AD 1600-1955.5 and from high-precision data in AD 1955.5-1990 are included in the dataset considered in this paper.

Using the change in the length of the mean solar day (l.o.d.) in units of milliseconds per century (ms/cy) as the measure of acceleration in the rate of rotation, it is found that the l.o.d. has increased by (+1.70±0.05) ms/cy [$\equiv (-4.5 \pm 0.1) \times 10^{-22}$ rad/s^2] on the average over the past 2700 years. Yet an increase of +2.3±0.1 ms/cy [$\equiv (-6.1 \pm 0.4) \times 10^{-22}$ rad/s^2] is expected from the tidal braking of the Earth's spin, assuming a value of -26.0 ″/cy^2 for the tidal acceleration of the Moon.

There is thus an average accelerative component in the Earth's rotation which acts to shorten the l.o.d. by (−0.6±0.1) ms/cy [$\equiv (+1.6 \pm 0.4) \times 10^{-22}$ rad/s^2]. This result is consistent with the change in l.o.d. implied by modern measurements of $\dot{J}_2$ and the theory of post-glacial rebound.

Moreover, it is found that besides this accelerative component there is a fluctuation in the l.o.d. with a semi-amplitude of ~ 4 ms and a period of ~ 1500 yr. This may have its origin in core-mantle coupling.

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