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Gravitational Interactions of the Solid Core and the Earth's Mantle and Variations in the Length of the Day

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A simple mechanical model explaining the long-period (about 100-year) variations in the Earth's rotational velocity [1] is proposed. This model takes into account the gravitational interaction of the mantle with the solid core of the Earth and the fact that the core rotation leads that of the mantle. Well known Earth parameters provide estimates of the gravitational torque that support the proposed model. The mathematical problem involved reduces to the classical problem of a nonlinear rotating oscillator exposed to a constant torque [2]. The well-known parameters of the core–mantle system result in a stable equilibrium and a stable limiting cycle on the phase cylinder of this oscillator. This equilibrium corresponds to a single angular velocity for the mantle and solid core, with no long-period oscillations in the length of the day. The stable limiting cycle corresponds to the core rotation leading the mantle rotation. Several observations (see [3,4] for example) show that the solid core-mantle system resides just in this state. In this case, the ellipsoiddality of the gravitationally interacting bodies provides a periodic interchange of kinetic angular momentum between the mantle and solid core that leads to long-period variations in the length of the day. The proposed model refutes the formerly widespread belief that the core rotates slower than the mantle.

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References
1. Excess of the Duration of the Day over 86400S and Angular Velocity of the Earth's Rotation since 1623, http://hpiers.obspm.fr/eop-pc/earthor/ut1lod/lod-1623.html
2. A. A. Andronov, A. A. Vitt, and S. E. Khaikin, Theory of Oscillators (Fizmatgiz, Moscow, 1959; Pergamon, Oxford, 1966).
3. X. Song and R.G. Richards, nature 382, 221 (1996).
4. V.M. Ovchinnikov, V.V. Adushkin, and V.A. An, Dokl. Akad. Nauk 362, 683 (1998)