Canonical treatment of dissipative forces between Earth core and mantle

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Abstract

Getino and Ferrándiz (1995) applied a Hamiltonian approach to the study of the effect of the deformations of an elastic mantle on the Earth rotation. Later, Getino (1995a, 1995b) considered, in a similar way, the problem of the liquid core and the influence of the inertial interaction term. As a particular merit, these works point out a possibility of extending the canonical theory for the rigid Earth developed by Kinoshita (1977) to the case of a deformable Earth. This can be accomplished by following the same procedure, and then, taking advantage of the simplicity of such a powerful formulation.

In this paper we perform a new step in our investigation, dealing with the interaction due to the frictional forces between mantle and core. First, the dissipative forces are formulated in a canonical form starting from the procedure of Kubo (1979), but using the more suitable set of canonical variables worked out by Getino (1995a, 1995b). Next, we carry out a canonical integration of the Hamiltonian following the guidelines of some canonical perturbation methods for non-conservative systems such as those of Choi and Tapley (1973) and Tveter (1994). A numerical estimation shows that the effect of the friction on the amplitude of the nutation is small. However, due to these forces, phase angles appear. This effect is not obtained by the well-known theory of Wahr (1981).

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We emphasize that, at this stage of the investigation, the main aim of this paper is not the obtaining of values for the amplitude and the phase of the nutation according to the observational data, but to extend the canonical formalism to a more realistic Earth model, in order to get in the future a complete Hamiltonian theory explaining the most important effects concerning the Earth rotation.

Key words: Geopotential, Solid tides, Elastic Earth.

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