Influence of the liquid and solid core in the tidal variation of geopotential

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Abstract

The accuracy levels achieved in obtaining and dealing with satellite data means that the coefficients of the development of the Earth's gravitational potential can no longer be considered as constants, but as functions of the time. The most studied variation, both theoretically and experimentally, is that of the J_2, which, on the other hand, produces the greatest indirect effect on the observations as they are closely related to the variation of the main moment of inertia and of the universal time, the latter reaching more than 2 ms. The LAGEOS data analysis allowed Yoder *et al.*, already in 1983, not only to identify and improve the predicted values of the periodical variations of J_2 of tidal origin, but also a secular decrease associated with post glacial phenomena and other unexplained effects.

However, the knowledge of the effect of other zonal or tesseral harmonics has shown less progress, and its experimental calculation presents greater problems although it is usually acknowledged that the uncertainty in the values of the low order harmonics should be diminished if global models with real centimeter or subcentimeter accuracy are to be obtained.

In previous papers, Ferrándiz and Getino (1993) and Ferrándiz, Getino and Caballero (1993), the problem of the analytical prediction

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of the tidal variations of zonal or tesseral harmonics for the first terms of the geopotential is undertaken. Later, in Getino and Ferrándiz (1994) analytical expressions for any order n are obtained. The process followed is essentially similar to that used by the authors in their Hamiltonian theory for the Earth's rotation, in such a way that the solution is calculated directly in terms of integrals of functions that include the displacement vector components obtained starting from a selected Earth model, so the result depends above all on experimental data of a geophysical kind. Notice that the study is limited to the contribution of the mantle.

This paper is an extension of the previous ones, where the effect of the deformation of the liquid outer core (LOC) and solid inner core (SIC) is taken into account. We perform a numerical integration of the elasticity differential equations in order to obtain the necessary parameters to compute the effect of the tidal deformation of the whole Earth. Numerical tables showing the periodic variation of coefficients are given, as well as a new prediction for $\Delta UT1$. For δJ_2 and δJ_{22} the amplitudes reach such a magnitude that both two variations should not be ignored in studies involving the analysis of highly precise satellite tracking data.

Key words: Geopotential, Solid tides, Elastic Earth.

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