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Earth's rotational modes and outer core dynamics

Y. Rogister (1) and **B. Valette** (2)

(1) E.O.S.T., Strasbourg, France, (2) I.R.D., Université de Savoie, France
(bvale@univ-savoie.fr / Fax: +33 4 79758742)

We investigate the influence of the outer core structure on the Earth's rotational modes through the squared Brunt-Vaisala frequency N^2. First, we describe the continuous spectrum of inertia-gravity modes in the complex domain and we show how it is governed by N^2 and the Earth's rotation speed. The rotational mode frequencies, which correspond to the Chandler and inner core wobbles and the nearly-diurnal free nutations (FCN and FICN), are all imbedded into this continuous spectrum. Therefore, the interaction between the rotational modes and the core dynamics is an important issue. Then, we solve the local equations for the normal modes of a rotating ellipsoidal Earth model by using a truncated chain of coupled spheroidal and toroidal displacements of the same harmonic order 1 or -1. By varying the N^2 parameter and increasing the length of the coupling chain, we show, for some N^2 intervals, bifurcations between core mode branches and the four rotational modes. For instance, in the case of the FICN, we find for some N^2 values two modes sharing similar displacements, i.e. an almost rigid wobble of the inner core and oscillations in the outer core, and having eigenperiods in an inertial frame separated by hundred of days. The same holds for the long-period wobbles but the interaction is clearly weaker for the FCN, though it does also exist. As a consequence, our results show that assuming a Poincaré motion in the outer core does not allow for a complete description of the interaction between the rotational modes and the core dynamics, especially for non-neutrally stratified models.