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Excitation of the motion of a cylindrical outer core

Chuichi Kakuta[1*]

[1]none

Wen(2006) showed that the Earth's inner core radius enlarged locally beneath middle Africa by 0.98 to 1.75 kilometers in 2003 than 1993 by using the arrival time differences of the P waves. We study the equatorial fluid motions and the rotational motions of the outer core associated with thermally upward motions at the inner core boundary (ICB). We assume, for simplicity, the outer core to be a thin cylinder around the Earth's rotational axis. Deformation of the ICB is expressed by the associate spherical function of the degree 1, Y11i (i =1,cos fai; i= 2, sin fai), and is assumed to move as a progressive wave with the period of 24 years. Fluid motions are discussed by using the sub-seimic approximation (SSA) derived from Smylie and Rochester (1981). The SSA alllows for the compressibiliy of the outer core. Only the vertical component of the pressure contibutes to the divergence of the velocity in the SSA.The outer core is assumed to be unstable. The normal displacement Ur at the surface of the thin outer core (CMB) is assumed to be the same value as the Ur at the ICB. Suppose the density of the eastern hemisphere rises up, the center of gravity of the thin cylinder moves 2Ur towards the eastern hemisphere. Non-asymmetric zonal flow couples with the density distribution of the 1st order,Y11i and induces the 2nd order angular momentum around the rotation axis. The magnitude of this angular momentum is of order 10 -11 of the rotaional angular momentum of the thin cylinder. Coupling of the second order of the equatorial flattening of the outer core and the shift of center of gravity of the thin cylinder can excite the outer core and the inner core libration.

Keywords: outer core, thin cylindrical outer core, inner core, density distribution, angular momentum, libration