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Fluid core dynamics and degree-one deformations: Slichter mode and geocenter motions

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Magnetic pressures as well as viscous tractions exist at the Core-Mantle-Boundary (CMB) and Inner Core Boundary (ICB) induced by the fluid motions. These internal pressures and tangential tractions involve degree-one deformations. Degree-one deformation has particular characteristics related to geodesy as well as to mechanics: it is related to the centre of mass of the Earth and is strongly dependent on the choice of the origin of the reference frame. If the reference frame is centered to the centre of mass of the Earth (as usual in elasto-gravitational studies), there is no possible degree one geopotential perturbations in the Free Space, and consequently, the total degree one force acting on the Earth has to be equal to zero. It imposes a relation on the degree-one coefficients of the pressures and tractions acting respectively at the boundary of the fluid outer core.
In this study, we analytically compute the degree one elasto-gravitational deformations for a simple Earth model (constituted of three homogeneous layers: a solid deformable inner core, a liquid outer core and an elastic mantle), and we present two geophysical applications: 1) First, at short time-scale, we investigate the Slichter mode and its possible excitation by dynamic pressure at the core boundary. 2) Second, at decadal time-scale, we compute the gravity perturbations and the geocenter motion induced by degree-one pressures and tractions at both CMB and ICB.