

The Earth's rotational normal modes

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The Earth, modelled with three major segments, a solid inner core, a liquid outer core and a solid mantle, flattened along the shared mean axis of rotation, is known to have four principal free modes involving wobble and nutation: two modes which are primarily long-period prograde motions in the terrestrial (Earth base) reference frame, the Chandler wobble (CW) and inner core wobble (ICW), and two modes which are primarily long-period oscillations in the celestial (inertial space) reference frame, the retrograde free core nutation (FCN) and the prograde free inner core nutation (FICN). The terms 'prograde' and 'retrograde' describe the motion of the rotation pole (whether as wobble about its mean position in the terrestrial reference frame, or as nutation about its mean position in inertial space) as being respectively the same as, or opposite to, the sense of the axial rotation itself. The inertial modes, which have the Coriolis force as their restoring force, with periods longer than half a day may also be excited in the Earth's liquid core. The periods and amplitudes of these modes depend on the Earth's interior properties and their detection may yield important information about the dynamics and properties of the Earth's deep interior. I will give a brief historical background on the study of these modes and will show that the FCN is indeed an inertial modes of the liquid core. I will also discuss the effects of density stratification in the liquid core on the periods of these models.