Anisotropy of the Inner Core and Changes of LOD

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The existence of anisotropy in the inner core is well established by studies of travel times of the seismic waves transmitting through the inner core along the polar path. Anisotropy appers between the eastern hemisphere of the inner core (40 deg E to 180 deg E)and the western hemisphere (180 deg W to 40 deg E). Sun et al. (2006) derived the travel time from South Sandwich Islands (SSI)(56.2 deg S,27.4 deg W) earthquakes to two polar paths with the aid of the ISC bulletins over 30 years. They obtained PKP(DF) (passing through the inner core) travel time residuals between a group of SSI-Alaskka (the western hemisphere) and SSI-Japan and Sakhalin, Russia(the eastern hemisphere). Following their results, we have a decadal variation in the travel time residual of PDP(DF) in the eastern hemisphere with the amplitude of 0.2 s and the period of about 20 years, though those variations in the western hemisphere are not clear. We obtain that a short travel time residual of the seismic waves in the eastern hemisphere shows correlation with an increase of the length of day (LOD).

Gravitational coupling arising from triaxiality of the inner core is preferred to explain the relationship between variations of PKP(DF) travel times and decadal variations of the LOD. A triaxial inner core caused by the surface mass variations on the eastern hemispphere of the inner core induce gravitational torques on the mantle shell.Gravitaional interactions between the inner core and the mantle cause the libration of the inner core and correspond to the eastward rotation of the inner core and the westward rotation of the mantle (increasing the LOD).Using the additional mass along the longitude of the eastern hemiphere,1000 km in the meridional direction being symmetrical with respect to the equator and 2 mm thick, the peiod of gravitational oscillation is 24 years. In the case of dominant gravitationsl torques, the magnetic torques produce magnetically damped oscillations of the inner core (Aurnou and Olson,2000). In order to maintain the decadal oscillations of the Earth, the magnetic torques may be small compared with those of gravitaional torques.