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Numerical theory of rotation of the deformable Earth with the two-layer fluid core. Fitting to VLBI data.

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Numerical theory of rotation of the deformable Earth with the two-layer fluid core is constructed and fitted to VLBI-detrmined offsets of the Celestial Pole positions, as well as to the variations of UT (series of Goddard Space Flight Center, 1984–2005). The resulting weighted random mean square (WRMS) errors of the residuals $d \theta$, $\sin \theta d \phi$ for the angles of nutation θ and precession ϕ are 0.136 mas and 0.129 mass, respectively. They are significantly less than the corresponding values 0.172 mas and 0.165 mas for the IAU 2000 model adopted as the international standard. In the numerical theory, the angles θ, ϕ are related to the inertial ecliptical frame J2000, the angle ϕ including the precessional secular motion. Processing the VLBI data has shown that beside the well known 435-day FCN mode of the free core nutation, there exits a second mode, FICN, caused by the inner part of the fluid core, with the period of 420 day close to that of the FCN mode. Beatings between the two modes are responsible for the apparent damping and excitation of the free oscillations, and are implicitly modeled in the numerical theory. The nutational and precessional motions in the numerical theory are proved to be mutually consistent but only in case the relativistic correction for the geodetic precession is applied. Otherwise, the overall WRMS error of the residuals would increase by 35 $\%$. Thus, the effect of the geodetic precession in the Earth rotation is confirmed experimentally. The other finding is the reliable estimation $\delta_c= 3.844^{\circ} \pm 0.028^{\circ}$ of the phase lag δ_c of the tides in the fluid core. When processing the UT variations, a simple model of the elastic interaction between the mantle and fluid core at their common boundary made it possible to satisfactory describe the largest observed oscillations of UT with the period of 18.6 year, reducing the WRMS error of the UT residuals to the value 0.18 ms (after removing the secular, annual and semi-annual terms).