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Influence of the Earth's fluid core rotation in polar drift

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Analysis of astronomical observations show that the Earth mean rotation pole experiences a slow secular drift. This behavior is mainly explained in terms of the mantle glacial isostatic adjustment (GIA), although other geophysical processes have been suggested. Among them, motions of the fluid outer core (FOC), which could account for the geomagnetic field drift, have not been deeply investigated. This fact represents a remarkable difference with respect to the last theories considered by the International Astronomical Union (IAU), which require the inclusion of the FOC to describe the Earth rotation.

In this work, we apply the Poincaré's formalism to a two-layer Earth model composed of mantle and fluid core. Here we show that long term variations in the inertia matrix of the core, possibly caused by the geodynamo, introduce new terms in the equations of motion, which affect both the polar drift and the rotation rate of the Earth (J2 variation). Besides, GIA induced changes in the mantle mass distribution give rise to a tilt of the rotation axis of the core. By means of this simple analytical approach it is shown that the inclusion of the core reveals as an essential enhancement in the understanding and modeling of polar drift, as it is the case of IAU rotation models.

The results of our study could play a relevant role in constraining mantle viscosity profiles, when they are estimated from polar drift and J2 variation observational data. In addition, this research can provide valuable information about the structure of the liquid core, as well as to help to investigate the complex geomagnetic phenomena associated to the rotation of this fluid layer.