地磁気データから推定されるコア表面渦度の時空間変動

Spatial and temporal variation of vorticity at the core surface estimated from geomagnetic field data

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Fluid motion near the Earth’s core surface provides useful information on core dynamics, and it can be estimated from spatial and temporal distributions of the geomagnetic field. Most of core surface flow models rely on the frozen-flux approximation, in which the magnetic diffusion is neglected for a large-scale magnetic field with time scales much shorter than magnetic diffusion time. It should be noted, however, that there exists a viscous boundary layer at the core-mantle boundary (CMB), where the magnetic diffusion may play an important role in secular variations of geomagnetic field. Keeping this in mind, a new approach to estimation of core surface flow has been devised by Matsushima (2015). That is, the magnetic diffusion is explicitly incorporated within the viscous layer, while it is neglected below the boundary layer.

A core surface flow model between 1840 and 1990 has been derived from a geomagnetic field model, gufm1 (Jackson et al., 2000). Temporal variations of the flow model contain information on phenomena in relation with core-mantle coupling, such as the LOD (length-of-day), and spin-up/spin-down of core flows. In particular, core surface flows inside the viscous layer at the CMB may reveal an interesting feature in relation with Earth’s rotation.

In this paper, we have examined time series of the LOD, kinetic energy of core surface flow, and vorticity derived from the flow model. We could not find any clear correlation between the LOD and kinetic energy of core flow within the boundary layer, and rates of changes in the LOD and the kinetic energy. Also the z-component of global vorticity calculated from core surface flows inside and below the boundary layer was turned out to have little correlation to the LOD. By focusing on a specific longitude or latitude, however, the z-component of local vorticity reveals moderate correlation to the LOD. This result may be explained in terms of conservation of the potential vorticity.

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