Dynamic effects of the geomagnetic field on the modeling of core surface flow

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Fluid motions in the Earth's core give rise to secular variations of the geomagnetic field. Such core flows can be estimated from spatial and temporal distributions of the geomagnetic field. When one relies on the frozen-flux approximation to estimate a core surface flow, the magnetic diffusion term in the induction equation is neglected. However, in reality, there exists a viscous boundary layer at the core-mantle boundary (CMB), where the magnetic diffusion can play an important role in secular variations of geomagnetic field. Hence, Matsushima (2015) has devised a new approach to the modeling of core surface flow; the magnetic diffusion is explicitly incorporated within the viscous boundary layer, whereas it is neglected below the boundary layer at the CMB. It should be noted that the tangentially geostrophic constraint is also used for the flow below the boundary layer. That is, the dynamic effects of geomagnetic field on the modeling of core surface flow have not been taken into account so far. Here, the tangentially geostrophic constraint is relaxed, and the tangentially magnetostrophic constraint is used, as carried out by Asari and Lesur (2011).