Temperature perturbation at ICB induced by CMB heat flux variation in numerical dynamos

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Recent seismic tomographies suggests that seismic velocity variation at the bottom of mantle is dominated by degree 2 component of the spherical harmonics. It is widely considered that this variation corresponds to the heat flux variation at the core mantle boundary (CMB), and that convection of iron alloy and geodynamo are also under the influence on this heat flux variations. Furthermore, seismic observation also suggests that inner core has seismic velocity anomaly with degree 1 of the spherical harmonics. These seismic heterogenities are generated by the thermal or compositional heterogenieties at the CMB and inner core, and convection in the outer core is under the influence of these heterogenieties. In the present study, we investigate how much thermal heterogeneity at CMB can generate the thermal heterogeneity at the ICB by using a numerical dynamo model.

In the present study, we perform dynamo simulations with changing amplitude of the heat flux variation at CMB with fixing dimensionless numbers. We choose the Y_2^2 component of the spherical harmonics for the heat flux variation. The amplitude of the perturbation q^* is defined by ratio of the perturbation to the average heat flux at CMB.

The results suggests that the temperature perturbation with Y_2^2 component at ICB is generated by the given heat flux variation at CMB. However, the amplitude of the Y_2^2 component is approximately 30% of the temperature perturbation with Y_2^0 component which is generated by the convection of the outer core. In the present simulations, magnetic field is not sustained in the cases with $q^* > 1.403$. By exploration of the results with sustaining the magnetic field, the Y_2^2 component of the temperature perturbation will exceed the Y_2^0 component at ICB in $q^* > 130$.

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