

The influence of fixed flux conditions on convections and dynamos

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The influence of thermal conditions at the core-mantle boundary on the planetary magnetic field has been addressed by several authors. Most focus on the effect of heterogeneous patterns. However, even an uniform fixed temperature or flux condition can affect the structures of flow and magnetic field.

A roll of the flux condition is to enlarge convective patterns in a rapidly rotating system with presence of a magnetic field. This effect may differ between bottom-heated and volumetrically-heated cases. Here we examine the influence of flux conditions on the convective structure in dynamos driven by the different heating modes.

We found that the fixed flux condition at the outer boundary enlarges the convective structures, for dynamos driven by volumetric heating. For bottom-heated dynamos, however, the flux condition at the inner rather than at the outer boundary promotes larger convective cell. Since volumetric heating would be the driving source in cores without an inner core, our results suggest that the early dynamos of Earth and Mars are more sensitive to the thermal boundary condition imposed by the mantle, than the present geodynamo.