Inverse geodynamo modeling to construct geomagnetic field models and dynamo scaling-laws

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Inverse geodynamo modeling has been employed for the modeling of the geomagnetic secular variation and the results were used to obtain candidate models for recent International Geomagnetic Reference Field (IGRF). There were no contributions on the determination of IGRF from Japan so far but we are planning to contribute on it in the future by presenting geomagnetic field models based on data assimilation.

It is well-known that the numerical dynamo modeling has been performed using parameter values far from those of Earth and planetary dynamos due to limitations of numerical computations. Validity of applying the numerical results on the studies of Earth and planets has been shown in several ways. For example, Christensen (2010) demonstrated that the scaling-law on the magnetic field strength obtained by numerical dynamo models by assuming the balance between the power supplied by the buoyancy flux and that dissipated by the Joule heat could predict the magnetic field strength of the planets rather well. Also, Christensen et al. (2010) showed a parameter regime in which the characteristics of spatial distribution of the geomagnetic field could be reproduced by numerical dynamos. Although the success of the scaling-laws, it is not clear whether the parameters assumed to deduce the scaling-laws, such as the length-scale of the magnetic field in the dynamo, are appropriate to discuss the planetary dynamos using numerical dynamos, i.e., whether they are common to both dynamos. In this presentation, we are going to examine the assumptions for the dynamo scaling-laws to clarify whether they are appropriate to discuss the geodynamo. Also, time-scales of the magnetic field variation in the numerical dynamo and geomagnetic field are discussed to clarify the conditions for the use of the information obtained by numerical dynamo models on geomagnetic field modeling.

Reference:

Christensen (2010) Space Science Review, 152, 565-590.
Christensen et al. (2010) Earth and Planet. Sci. Lett., 296, 487-496.