Long-term secular variation in dynamo simulations

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Geomagnetic secular variation provides a way to characterize dynamo processes in the Earth's outer core. Thanks to recent developments in paleomagnetic and rock magnetic measurement technique, some models of global paleosecular variation have been constructed, although uneven distribution of data in terms of location and age should be kept in mind. In contrast, numerical dynamo simulation has advantages regarding such matters. Here we use numerical dynamo modeling to offer interpretation of geomagnetic paleosecular variation and its connections with dynamo action in the core. Since we primarily focus on statistical behavior of paleosecular variation, long-term (typically longer than 1 Myrs) dynamo simulations are required. However, it is extremely difficult and time-consuming to carry out such a long-term dynamo simulation with state-of-the-art parameters. To handle this problem, we have to adopt a higher value of Ekman number (E) by compromise. Some of the parameter values used in this study are fixed at E = 3.25 x 10^{-3}, Pr (Prandtl number) = 1, Pm (magnetic Prandtl number) = 20, whereas Ra (Rayleigh number) is varied to see effects of flow vigor. We will report our preliminary analysis of secular variation in numerical dynamos.

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