Preliminary analysis of a jerk-like magnetic field variation detected in a numerical dynamo model

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The geomagnetic field, which is generated by the geodynamo, varies in a wide range of time scale. Focusing on short time scale variation, it is well known that a sudden and abrupt change in the first time derivative of the geomagnetic field (a V-shape-like change) occurs in typically one year. This abrupt change is called the geomagnetic jerk. Although we don't fully understand the mechanism of the geomagnetic jerk, it is said that the geomagnetic jerk is of internal origin in a broad sense.
In this study, we use a numerical dynamo modeling to see whether or not any jerk-like magnetic field variation can result from a dynamo model at a reasonably low Ekman number. The adopted values of the Ekman number in the model is 3×10^{-5}. We investigate three components of the dynamo-generated magnetic field at the core-mantle boundary and the model Earth's surface truncated at spherical harmonic degree 12 according to geomagnetic observations. In time series at a selected position, we find some V-shape changes in secular variation accompanying rapid changes from negative to positive values and vice versa in secular acceleration. Such variation is not always observed in three components, and shows some delay in a certain component. These variations occur typically in 5×10^{-4} in magnetic diffusion time unit. Although it should be kept in mind that secular variation time scale in the dynamo model may not correspond to that in the geomagnetic field mainly because of vast difference in the Ekman number, these features are similar to those of the geomagnetic jerk. The results suggest a possibility that numerical dynamos could generate even rapid magnetic field variation such as jerk, and also that some geomagnetic jerks might be purely of core origin.

Keywords: geomagnetic jerk, dynamo, numerical simulation

