Data assimilation for prediction of geomagnetic secular variation

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The terrestrial magnetic field is generated by a dynamo in the outer core of the Earth. Since the physical processes of the geodynamo is nonlinear, it is difficult to predict the geomagnetic secular variation in the future. It is therefore desired to make use of a physical geodynamo model for the prediction of the secular variation. Data assimilation of geomagnetic data on the Earth's surface is essential for the prediction based on the physical model.

In this study, the geomagnetic field given by the MCM-0020 model (Ropp and Lesur, 2019) is assimilated into a geodynamo model (Takahashi, 2012; 2014) by using the 4-dimensional ensemble variational (4DEnVar) method (Liu et al., 2008), which is easy to implement if the results of a large number of simulation runs are prepared in advance. By iteratively applying the 4DEnVar method, the estimate converges to at least a local maximum of the log-likelihood function. It will be demonstrated that this method provides a plausible estimate of the current state of the geodynamo.