PREDICTION OF GEOMAGNETIC SECULAR VARIATION USING DATA ASSIMILATION TECHNIQUES

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An important part of geopotential research is to develop models of the time-varying geomagnetic field, not only for scientific use but for practical purposes. The IGRF is the most commonly used model of the field; a very important aspect of this model is the secular variation (SV) model, from which predictions of the field are calculated up to 5 years after the initial epoch. This predictive model is currently calculated from observations alone. Here we propose a new approach, assimilating geomagnetic observations to geodynamo models for SV prediction.

Assimilation of measurements and numerical models has been widely used in atmospheric and oceanic studies to better estimate the true dynamical states and to predict more accurately the changes of the observables in future. Similar approaches could be very useful for geomagnetic field modeling, in particular prediction of geomagnetic secular variation (SV) on decadal time scales. We have developed a geomagnetic data assimilation system (MoSST_DAS) to combine geomagnetic field model output for the past 7000 years and our numerical core dynamics model to better constrain the (numerical) core state, and to predict geomagnetic field and secular variations up to 20 years. Our forecast is very accurate. For 5-year forecast, the correlation between the field morphologies at the core-mantle boundary is greater than 99.5% over the 20th century, while the correlation between SVs is larger than 95%. To examine the broad applicability, we are modifying the assimilation process to best emulate the standard practice (e.g. IGRF) in the geomagnetic community, and to benchmark our results with those documented and published in the past.

Secular variation, geodynamo, data assimilation, prediction

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