FORECASTING CHANGE OF THE MAGNETIC FIELD USING CORE SURFACE FLOWS AND ENSEMBLE KALMAN FILTERING

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Accurate forecasting of the change of the Earth's internal magnetic field over short intervals of time (e.g. less than five years) has many applications for government, academic and commercial users. Forecasting can be achieved by making a number of reasonable assumptions about how the main field interacts with the flow in the liquid outer core. In particular, the magnetic field can be considered to be entrained in the large scale flow along the core-mantle boundary surface over short time periods, giving rise to measurable change of the field at the Earth's surface. The observed change (or secular variation) at or above the surface of the Earth can thus be inverted to produce flow models; these can be used to propagate fluid parcels threaded by the field forwards in time to forecast the non-linear change of the magnetic field. In addition to prediction of field change by flow models, it would be advantageous to include new observations of the field from satellite measurements or ground-based observatories. We therefore present a method using Ensemble Kalman Filtering (EnKF) to produce an optimal assimilation between magnetic field change as forecast from core flow models and direct observations of the field. We show, by assuming a steady flow and assimilating field observations annually, it is possible to produce a forecast over five years with less than 20nT root mean square difference from the `true' field. The EnKF method also allows for a sensitivity analysis of the field models to noise and for uncertainty within the physical representation.

Satellite Data; Core Flow; Magnetic Forecast;

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