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Invited Talk

Stochastic Core Flow Reconstruction Over the Observatory Era

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We consider the problem of core dynamics reconstruction, for which we differentiate between stochastic and deterministic forces that sustain the flow evolution. The former is associated with the impossibility of completely representing the forces as the magnetic field is not resolved at small length-scales. An illustration of the latter is the propagation of torsional Alfven waves at interannual periods. However, this only concerns a tiny part of the observed geomagnetic secular variation (GSV), for which a dynamical understanding still has to be developed.

This quest requires to build a consistent model for the GSV uncertainties, in order to best extract the information contained in magnetic records. If progresses have been made along those lines over the past decade, GSV error statistics still need to be improved. Here we propose a stochastic approach by which all the prior statistical information about the GSV is formally accounted for, through a dense covariance matrix for both measurement and modeling error.

We give an example in the simplest case where the prior on the flow trajectory is a random walk (zero deterministic component), by inverting for flow increments backward in time, starting from the best constrained satellite era. The consistency between the flow and GSV priors is discussed. We propose an extension of this work where both deterministic and stochastic forces are considered, within the framework of data assimilation.