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Dynamics of locked dynamo simulations

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We have found a nearly-steady regime of numerical dynamo solutions incorporating inhomogeneous heat-flux boundary conditions. These solutions exhibit the four-fold symmetry of the Earth's present field, with main patches of intense magnetic flux at mid to high latitudes. The precise form of the solution is very sensitive to the values of the input parameters. This work investigates the response of the system to changes in the Rayleigh number, Ekman number, and ϵ, a measure of the amplitude of lateral variations in heat flux. Changes in time dependence, from chaotic, through oscillatory, to steady solutions are obtained. Localised convection and failure of the dynamo are some of the interesting features reported. The roles of the inhomogeneous boundary condition and magnetic field in the transition sequence are analysed.