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Electrical conductivity of the deep mantle: Joint inversion approach based on EM induction by external sources and rapid changes of secular variation

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The basic idea of this study is to combine two different, previously established techniques to study the electrical conductivity of the Earth's deep mantle, into one joint inversion scheme. Both methods are based on time-domain integration of electromagnetic induction equation in the Earth's mantle with one-dimensional, depth-dependent electrical conductivity. In the first forward problem, external excitation by intense geomagnetic storms is assumed, while in the second forward problem, induction by rapid changes of secular variation of the main field at the core-mantle boundary (the geomagnetic jerks) is studied.

Different time scales of both approaches lead to use of two distinct datasets. Seven years of CHAMP satellite data is processed into time series of spherical harmonic coefficients with 1 hr sampling rate and used in the external induction problem. Annual means provided by Intermagnet observatories for selected 20th century jerks, are used in the modelling of secular variation.

The joint inversion aims to recover both the radial profile of mantle conductivity, and the unknown spatial structure of the secular acceleration at the CMB for each jerk. Limited-memory quasi-Newton technique is used to minimize the misfit, complemented by effective evaluation of data sensitivities based on solutions of adjoint problems.

First results of the inversion suggest only small increase of electrical conductivity to values about 10 S/m in D".