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A new model of Earth's radial conductivity structure derived from over 10 years of satellite and observatory magnetic data

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We present a new model of the radial (1-D) conductivity structure of Earth's mantle. This model was derived from more than ten years of magnetic measurements taken by the satellites Ørsted, CHAMP, SAC-C and the Swarm trio as well as the global network of geomagnetic observatories. After removal of core and crustal field as predicted by a recent field model we fit the data with spherical harmonic coefficients describing ring current activity and associated induction effects, and estimate global C-responses at periods between 1.5 days and 150 days. An iterative approach is used to correct the estimated C-responses for 3-D effects arising from induction in a heterogeneous surface shell that takes into account the distribution of oceans and continents.

We invert the corrected C-responses for a 1-D model of mantle conductivity using both probabilistic and deterministic methods. The different methods yield very similar results, consisting of a highly resistive upper mantle, a conductive lower mantle, and an increase in conductivity in and beneath the transition zone. Analysis of the Hessian of the cost function reveals that the data are most sensitive to structures at depths between 700 km and 1200 km, in agreement with the results obtained from the probabilistic approach. The recovered models feature a marked kink in this well-resolved depth range.