Conductivity structure beneath Australia constrained by 3-D inversion of tippers in spherical geometry

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SUMMARY

We present a new 3-D conductivity model of the Australian continent for part of the crust and upper mantle. The model was derived by inverting vertical magnetic field transfer functions (tippers), estimated from a combined data set at periods between 300s and 10000s. Specifically, we used data from the Australian Wide Array of Geomagnetic Stations (AWAGS) project and complemented them with geomagnetic observatory data from the MAGnetic Data Acquisition System (MAGDAS) and the British Geological Survey (BGS) data sets.

The challenging task of inverting tippers at a continental scale was addressed by performing inversion in a spherical frame and using a multi-scale approach with adaptively refined meshes to accurately account for the ocean effect and decrease of resolution with depth. This was made possible by a new formalism that allows modelling tippers on a sphere within the inversion code GoFEM. Furthermore, a spherical geometry set-up eliminates potential distortions caused by cartographic projections and paves the way to a natural integration of tippers with other longer-period electromagnetic (EM) responses from global sources.

Despite the limitations posed by the data set and survey layout, obtained conductivity model successfully images conductivity variations that correspond to major geologic features and boundaries, thereby providing new insights into the electrical structure beneath Australian continents and potentially serving as an initial guess for more detailed studies.

We consider this work as the first step in a broader study aiming at jointly inverting tippers and longer-period EM responses to obtain a 3-D conductivity model beneath Australia down to lower mantle depths.

Keywords: EM Induction – Magnetotellurics – Tippers – Electrical Conductivity – Australia