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Constraining Lateral Variations of Asthenosphere Electrical Conductivity Using Satellite-Detected Tidal Magnetic Signals

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SUMMARY

Data from CHAMP and Swarm satellites were shown to contain magnetic signals due to semidiurnal lunar tidal flow (Figure 1). They were recently used to image the global electrical structure of the oceanic lithosphere and upper mantle down to a depth of about 250 km (Grayver et al., 2016). This represents an important complement to the long-period magnetospheric responses, which lack resolution in the upper mantle. An open question is whether we can infer lateral variations in upper mantle conductivity from satellite-detected tidal magnetic signals and associate them with various tectonic processes in the upper mantle? This study presents a comprehensive 3D feasibility model study and 3D inversion results using real satellite data. The main challenge in trying to invert tidal magnetic signals is the necessity to account for the bathymetry of the ocean in the forward modelling step. Without this, the physics of the process cannot be reproduced reliably. This requires us using a full 3D global forward modelling code (Kuvshinov, 2008) in inversion, thereby putting high demands on the computational side. Further, to avoid disadvantages associated with the local optimization (deterministic) methods, we performed the inversion using a stochastic optimization algorithm (Grayver and Kuvshinov, 2016) and employ embarrassing parallelism this algorithm provides to run inversion efficiently on the cluster.

Keywords: inversion, satellite data, global induction, upper mantle

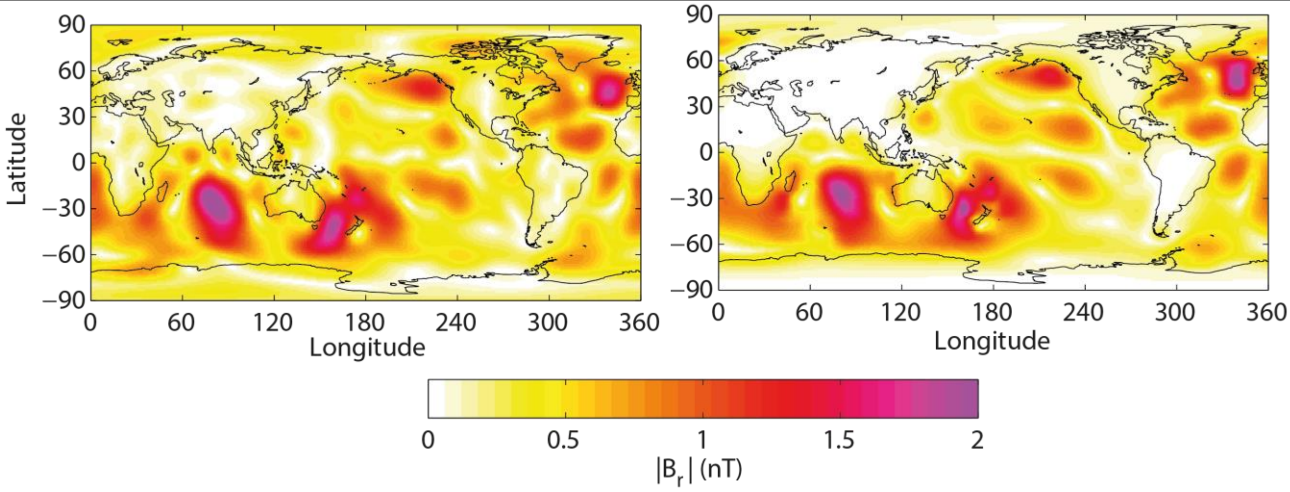

Figure 1. Observed (left) and predicted (right) tidal magnetic signals at the satellite altitude of 430 km.

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