Development of an efficient 3D inversion algorithm for large-scale MT data

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Abstract

We developed an efficient 3D magnetotelluric inversion algorithm employing a forward modeling scheme based on the radiation boundary method. The radiation boundary vector is estimated using coarse-mesh modeling for the user-defined inversion domain. Therefore, the proposed algorithm allows an arbitrarily shaped boundary of the inversion domain. Consequently, it minimizes the degree of freedom in an inversion process by reducing the number of cells for which the conductivity ought to be estimated. The developed algorithm is helpful for large inversion domains that arise due to the vast survey area or high-resolution imaging. The algorithm is created by augmenting these features into the AP3DMT algorithm. The versatility and efficiency of the inversion scheme are illustrated for synthetic and real field data. We considered the Rubik model for the synthetic experiment where data is simulated on two profiles intersecting at a right angle. The proposed algorithm estimates the resistivity of conductive blocks better than the inversion scheme based on the conventional modeling approach. At the same time, the computation time in this experiment reduces by more than six times. We also invert the SAMTEX MT data using the developed algorithm to illustrate the robustness of the proposed algorithm. The inverted model is in overall agreement with well-known structures (e.g., Kaapvaal and Zimbabwe cratons, Ghanzi-Chobe Belt).