Dealing with static shifts in MT surveys using Airborne EM

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Introduction

Our work tests the feasibility of using regional airborne FDEM data in place of time domain EM data for static shift corrections in the manner of Sternberg et al. (1988) and Pellerin & Hohmann (1990). The test area is a sedimentary basin in Northern Ireland, concealed beneath flood basalts.

FDEM data were inverted with the Airbeo 1D inversion program (Raiche, 1999), and MT data were inverted with the ModEM 3D inversion program (Kelbert et al., 2014).

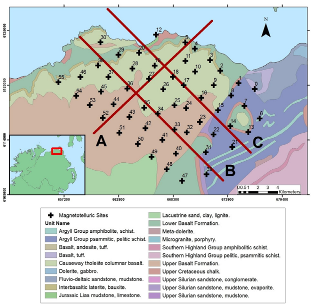


Figure 1: Location of MT sites, with surface geology and select profile locations overlain.

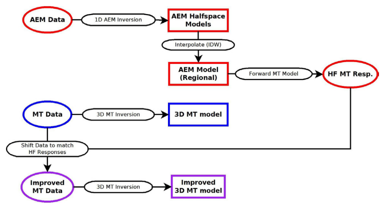


Figure 2: Flow chart showing the steps involved in correcting static shift of MT data with airborne FDEM data.

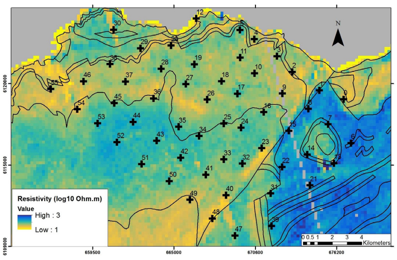
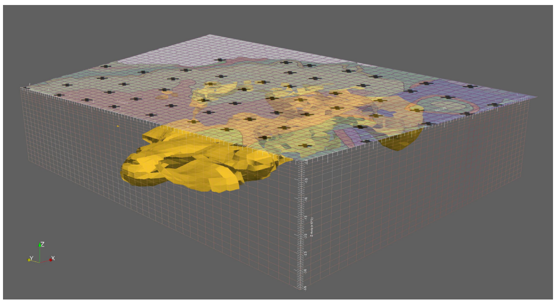


Figure 3: Halfspace resistivities found by 1D inversion with Airbeo, used as synthetic model for static-corrected MT responses.

Preferred Model - 10 Ωm isosurface



Static Shift Corrections

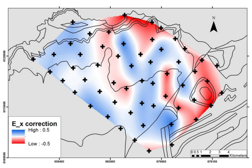


Figure 4: Spatial distribution of δ_{Ex}, the logarithmic static shift correction applied to E_x-dependent components.

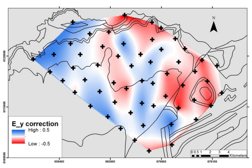


Figure 5: Spatial distribution of δ_{Ey}, the logarithmic static shift correction applied to E_y-dependent components.

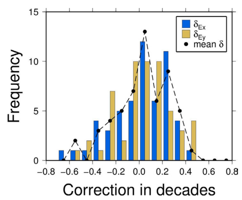


Figure 6: Logarithmic distribution of δ_{Ex}, δ_{Ey}, and the mean correction at each site, to examine the normality and central tendency of the respective distributions.

Model Comparison

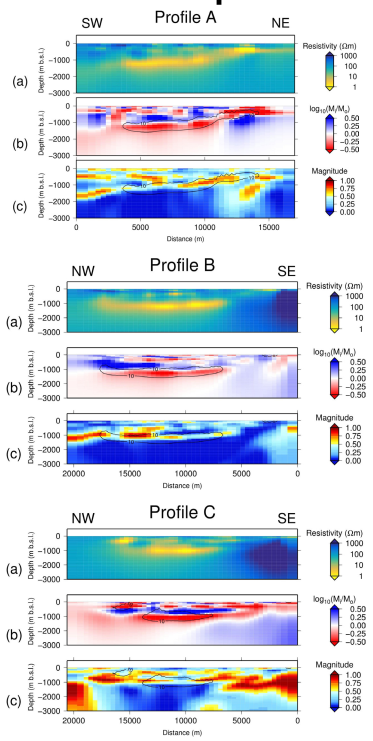


Figure 7: Profiles A, B, C taken through preferred model, with locations indicated in Figure 1. Subfigures (a) show the resistivity distribution, (b) show the logarithmic resistivity difference between the static-corrected model and the uncorrected model, and (c) show the normalised cross-gradient of the models.

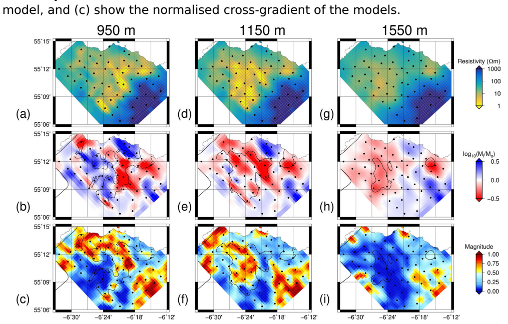


Figure 8: Depth slices taken through preferred model at 950, 1150 and 1550 m depth. Subfigures (a), (d), (g) show the resistivity distribution, (b), (e), (h) show the logarithmic resistivity difference between the static-corrected model and the uncorrected model, and (c), (f), (i) show the normalised cross-gradient of the models.

The static-corrected and uncorrected models were compared by two primary metrics, namely the logarithmic difference in resistivity (measured in decades), and the normalised cross-gradient (i.e. cross-product of gradient vectors of each model). The cross-gradient shows a maximum value in areas where the structures in each model differ significantly.

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