

Influence of Anisotropy and Development of 3-D Anisotropic Resistivity Inversion for Magnetotelluric Data based on WSINV3DMT

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SUMMARY

We investigated the influence of anisotropic resistivity elements on magnetotelluric (MT) surface responses, focusing on 3-D axial, dipping, and azimuthal anisotropy. Using influence indices for impedance components and edge effect indices for tipper components, we found that for decoupled modes, ρ_{xx} strongly influences Z_{xy} , Z_{yy} , and T_y , while ρ_{yy} affects Z_{yx} , Z_{xx} , and T_x . The elements ρ_{zz} , ρ_{xz} , and ρ_{yz} show a weak influence on all responses. For coupled modes, ρ_{xx} , ρ_{yy} , and ρ_{xy} significantly affect all responses. Based on these findings, we have developed two axial anisotropic inversion codes for MT data: full axial inversion and decoupled axial inversion, based on the data space inversion method of WSINV3DMT and implemented with OpenMP. Using the influence study, we split the inversion into ρ_{xx} and ρ_{yy} modes, reducing the data parameters by half for each mode, allowing independent execution. Testing against synthetic models and real MT data demonstrated that decoupled inversion reduces computational time and memory usage significantly. It also confirmed anisotropy at a depth of 60 to 160 km beneath the ocean floor, as suspected in the Northwestern Pacific Ocean data.

Keywords: Electrical anisotropy; Magnetotelluric; Inversion; Data space; Marine electromagnetic
