Geophysical Research Abstracts
Vol. 18, EGU2016-13769, 2016
EGU General Assembly 2016

Three-dimensional magnetotelluric inversion with distortion correction, practical experience and solution recipes

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The static distortion of magnetotelluric (MT) impedances is a common problem that can prevent detailed imaging of the subsurface. The effect of distortion on the undistorted impedance Z can be described as a multiplication with an unknown, real-valued matrix C. Inverting the observed impedance $Z_{obs} = C \cdot Z$ without any consideration of distortion can result in strong artefacts, particularly in the near-surface. As a consequence, a variety of approaches have been developed to remove as much of the distortion effects as possible or compensate for them in the inversion. However, these either reduce the number of data and thus potentially reduce resolution, or make assumptions about the properties of the matrices C and Z which might not be generally valid.

Recently we developed a new 3D inversion approach that includes the four unknown elements of C as parameters in the inversion and showed encouraging result with different synthetic test cases. In this presentation we will focus on the practical aspects of inverting real data with this approach. We will use a combined MT and transient electromagnetic (TEM) dataset acquired over the Kemaliye geothermal field in Turkey. We will demonstrate the improvements in imaging that can be obtained by incorporating distortion in the inversion. Having TEM data at each site, gives us some indication of the amount of distortion and we will compare our recovered distortion values with these measurements. Finally, we will also show in how far the inversion approach is robust in the presence of noise and present recipes for successful inversion with distortion correction.