Geophysical Research Abstracts
Vol. 19, EGU2017-9429, 2017
EGU General Assembly 2017

2D Inversion of Transient Electromagnetic Method (TEM)

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A new methodology was developed for 2D inversion of Transient Electromagnetic Method (TEM). The methodology consists in the elaboration of a set of routines in Matlab code for modeling and inversion of TEM data and the determination of the most efficient field array for the problem.
In this research, the 2D TEM modeling uses the finite differences discretization. To solve the inversion problem, were applied an algorithm based on Marquardt technique, also known as Ridge Regression. The algorithm is stable and efficient and it is widely used in geoelectrical inversion problems.
The main advantage of 1D survey is the rapid data acquisition in a large area, but in regions with two-dimensional structures or that need more details, is essential to use two-dimensional interpretation methodologies. For an efficient field acquisition we used in an innovative form the fixed-loop array, with a square transmitter loop (200m x 200m) and 25m spacing between the sounding points. The TEM surveys were conducted only inside the transmitter loop, in order to not deal with negative apparent resistivity values. Although it is possible to model the negative values, it makes the inversion convergence more difficult. Therefore the methodology described above has been developed in order to achieve maximum optimization of data acquisition. Since it is necessary only one transmitter loop disposition in the surface for each series of soundings inside the loop.
The algorithms were tested with synthetic data and the results were essential to the interpretation of the results with real data and will be useful in future situations. With the inversion of the real data acquired over the Paraná Sedimentary Basin (PSB) was successful realized a 2D TEM inversion. The results indicate a robust geoelectrical characterization for the sedimentary and crystalline aquifers in the PSB. Therefore, using a new and relevant approach for 2D TEM inversion, this research effectively contributed to map the most promising regions for groundwater exploration. In addition, there was the development of new geophysical software that can be applied as an important tool for many geological/hydrogeological applications and educational purposes.