# The application of geoelectrical methods for understanding the Punata aquifer (Bolivia)

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## Abstract

In many parts of the world, agriculture is the main social and economic activity. Consequently, agriculture becomes one of the principal uses of water, and the most common of get it is from surface water, e.g. rainfall, rivers, and lakes. However, climate change has affected the water budget in many regions of the world leading to severe shortages. Therefore, groundwater can be an important water source, and this importance becomes more evident in arid and semiarid areas, where there is a deficit in the surface water supply. In Bolivia, a semiarid region is the Punata alluvial fan, which is an agricultural zone. In the study area, the deficit in water supply led to the local people to drill boreholes, increasing considerably in the recent years. However, the real geometry of the aquifer system is partially unknown. In order to fill in the gaps and demonstrate the applicability of indirect data retrieved from geoelectrical methods several surveys were performed. Electrical Resistivity Tomography (ERT), Normalized Chargeability and Time Domain Electromagnetic (TDEM) surveys were performed in the Punata alluvial fan.

The ERT measurements proved to be a good tool for mapping the subsurface in alluvial fan, especially when used in combination with Induced Polarization parameters (i.e., Normalized Chargeability); the interpretation of the results showed an unconfined aquifer close to the apex fan, and a confined aquifer in the distal part of the fan, The TDEM sounding were performed in a grid of 150 m separation, which provided significant information for proposing 2-D and 3-D models where it is possible to analyze the lateral and vertical extent of the different layers. Moreover, TDEM measurements reached greater depths than ERT. TDEM method is sensitive to low resistivity features, and this sensibility assisted in identifying a thin layer with brackish water in the aquifer bottom. With the integration of the results and lithological information, a refined conceptual model is proposed; this model gives a more detailed description of the local aquifer system. It can be concluded that geoelectrical methods are useful for mapping aquifer systems in alluvial fans, and with the gathered information, further planning and policies can be proposed for a sustainable and appropriate groundwater exploitation.