Geophysical Research Abstracts
Vol. 21, EGU2019-9655, 2019
EGU General Assembly 2019

Improved hydrogeophysical characterisation by combined GPR, MRT and ERT investigation

Jan Igel (1), Chuandong Jiang (2), Raphael Dlugosch (1), Thomas Günther (1), Mike Müller-Petke (1), Julian Helms (2), Jörg Lang (2), and Jutta Winsemann (2)

(1) Leibniz Institute for Applied Geophysics, Hannover, Germany (jan.igel@leibniz-liag.de), (2) College of Instrumentation and Electrical Engineering, Jilin University, Changchun, China, (3) Institut für Geologie, Leibniz Universität Hannover, Hannover, Germany

Geophysical methods can characterize aquifer systems non-invasively and are particularly helpful in the absence of boreholes or in the presence of strong lateral variations of geological strata in the subsurface. For detailed investigations of shallow subsurface structures, ground-penetrating radar (GPR) is an effective tool to image the depositional and structural architecture with high resolution, but provides only limited information on hydraulic properties. On the other hand, nuclear magnetic resonance tomography (MRT) measurements conducted from the surface is a technique that provides the important parameters water content (porosity) and hydraulic conductivity via the proxy relaxation time. However, surface MRT, like electrical resistivity tomography (ERT) suffers from resolution limits and requires knowledge of the electrical resistivity, e.g., obtained by ERT.

We provide a workflow where the three methods GPR, MRT and ERT are combined so that high-resolution hydraulic models can be produced and applied to groundwater modelling studies. In this procedure, GPR reflections are implemented for optimizing the regularization characteristics of ERT and MRT data inversion, specifically as structural constraint that significantly improves the images.

The methodology is applied to field data from a test site that is characterized by a complex subsurface architecture of the quaternary sediments. Meltwater sand and gravel act as aquifers whereas the interbedded till is an important aquiclude. GPR is used to image the upper surface of the till in 3D and reveals sedimentary and glaciotectonic structures within the aquifer. On a 200 m long profile line, a multi-channel MRT setup is measured along with an ERT line. The individual results of the inversion image the subsurface architecture already well, however, including the structural GPR constraints improves the resolution and the readability for deducing hydraulic models. Comparisons with data obtained from drill-core analysis proves the applicability of the methodology and demonstrates the superiority of the joint approach over single conventional methods.