Geophysical Research Abstracts
Vol. 12, EGU2010-8657, 2010
EGU General Assembly 2010

Monitoring water infiltration for managed aquifer recharge using time-lapse electrical imaging: a numerical feasibility study

Klaus Haaken (1), Andreas Kemna (1), and Martin Sauter (2)

(1) Department of Geodynamics and Geophysics, University of Bonn, Germany (haaken@geo.uni-bonn.de), (2) Applied Geology, Geoscience Centre of the University of Göttingen, Germany

Managed aquifer recharge (MAR) is an innovative technology for sustainable management of water resources. For the successful design and application of MAR it is of particular importance to understand the entire flow system in the subsurface, for instance to prevent water losses via unknown hydraulic pathways. Conventional measurement methods such as measuring the groundwater head in boreholes may only provide limited insight into the system characteristics.

Here we investigate the potential of time-lapse electrical resistivity tomography (ERT) to characterise water flow and to determine relevant quantities, like infiltrated water volume, in vadose zone MAR applications. ERT has been proven a powerful non- to minimally invasive tool for the monitoring of water movement in the vadose zone given the direct influence of water saturation on the electrical resistivity. Particularly, ERT offers the monitoring of subsurface flow processes with high spatial resolution.

Numerical modelling using TOUGH2 (hydrogeological model) and CRMod (geoelectrical model) was carried out to simulate resistance measurements in a synthetic, heterogeneous vadose zone during an infiltration experiment. Water saturation is linked to electrical resistivity by means of a petrophysical model. The synthetic data were inverted using the ERT imaging code CRTomo, and the obtained resistivity images were back-transformed to water saturation based on the adopted petrophysical model.

The imaging results reveal the infiltration pattern in the subsurface. Importantly, low and high permeable zones are correctly delineated. Using different ERT inversion approaches, in particular the potential of recovering the infiltrated water volume is investigated.

The synthetic study was designed as a feasibility study for a planned MAR field experiment in the Lower Jordan Valley (West Bank), where water scarcity and salinity is a major issue. Seasonal rainfall in the West Bank Mountains flows as both surface run-off and spring discharge from hill slopes through wadis into the valley. This water resource is intended to be stored in alluvial aquifers to meet water demand in dry seasons in the arid Jordan Valley, where agriculture represents the main economical activity and requires large quantities of irrigation water.