Geophysical Research Abstracts
Vol. 21, EGU2019-5214, 2019
EGU General Assembly 2019

Inversion of discrete fracture networks by hydraulic and tracer tomography

Lisa Ringel (1), Márk Somogyvári (2), Mohammadreza Jalali (3), and Peter Bayer (1)

(1) Institute of new Energy Systems (InES), Technische Hochschule Ingolstadt, 85049 Ingolstadt, Germany, (2) Institute of Mathematics, University of Potsdam, 14476 Potsdam-Golm, Germany, (3) Chair of Engineering Geology, RWTH Aachen, 52064 Aachen, Germany

This study is dedicated to the characterization of connected fractures in a hard rock aquifer by invasive tomographic methods. Two of these methods are compared: tracer tomography and hydraulic tomography. Both are typically applied as cross-well tests with a tomographic configuration. This means that multiple tracer or hydraulic pressure signals are injected in one source well, and recorded at different levels in a nearby receiver borehole. The recorded data carries information on the spatially variable conditions in the rock mass, and with this, the heterogeneous hydraulic properties along the cross-well profile can be reconstructed. In our work, we focus on the reconstruction of fractures in a discrete fracture network (DFN). The fracture numbers and positions are treated as inversion variables that are adjusted adhering to given statistical information such as fracture length, orientation, and density. The objective of this inversion procedure is to reproduce recorded tracer breakthrough and pressure pulses in a numerical DFN model. The DFN reconstruction is accomplished by using a transdimensional reversible jump Markov chain Monte Carlo methodology (rjMCMC). This iterative procedure modifies fractures randomly by flexible fracture movement, insertion, and deletion.
A synthetic example is set up based on an outcrop of a field site in Switzerland. This example has two fracture sets with different orientations, and hydraulic and tracer tests are theoretically simulated. The inversion produces a fracture probability map for the cross section between the virtual source and receiver boreholes. It is demonstrated that a majority of fractures can be identified by both concepts. In the chosen example, both tomographic tests deliver promising results. These findings, however, need to be examined further with respect to the role of test configuration and fracture network characteristics. Ideally, a coupled inversion procedure is derived that exploits synergies from the two tomographic test variants.