Geophysical Research Abstracts
Vol. 21, EGU2019-6145, 2019
EGU General Assembly 2019

Characterizing the spatial hydraulic properties at a gas and heat storage site using three-dimensional cross-well pumping tests

Linwei Hu (1), Márk Somogyvári (2), and Sebastian Bauer (1)

(1) Kiel University, Institute of Geosciences, Germany (linwei.hu@ifg.uni-kiel.de), (2) University of Potsdam, Institute of Mathematics, Potsdam, Germany

Subsurface energy storage is proposed as a method to mitigate seasonal fluctuations of renewable energy sources, such as solar or wind power. The excessive energy generated in high seasons can be converted to “energy gas” (e.g., methane, hydrogen, compressed air) or thermal water, which is then stored in the subsurface and retrieved in low seasons. However, heterogeneity of the storage formation may have a significant impact on the achievable storage capacity, rates and the lifespan of the storage system. Therefore, a detailed characterization of the formation heterogeneity is advantageous prior to installing a gas or heat storage site. In recent years, many studies have shown that hydraulic/pressure tomography (HT/PT) can yield high-resolution spatial distributions of hydraulic conductivity and specific storage of the subsurface. In this study, we employ the HT technique at two pilot sites at Wittstock, Germany, as part of the Testum-Aquifer project in order to derive the baseline hydraulic information of the target aquifers before methane and heat injection experiments. At the sites, multilevel pumping tests were conducted using pumping wells and multiple observation wells to generate a three-dimensional tomographic configuration. In total, 198 drawdown curves were obtained. These data are denoised and then used for the inversion of hydraulic properties. First, we apply a hydraulic traveltime and attenuation based method to reconstruct the three-dimensional distribution of hydraulic diffusivity and specific storage. In addition, we explore the effect of double-packer screen length on calculating hydraulic travel times and attenuation. Sequentially, the inverted diffusivity tomograms are clustered, and a zonal inversion method is implemented. Besides the two aforementioned approaches, we develop a smart-pilot-point method based on the reversible jumping Markov Chain Monte Carlo (rjMCMC) algorithm, in order to achieve a more detailed heterogeneity reconstruction. Finally, the inversion performance of these three inversion methods is compared and evaluated.