EGU22-6638
https://doi.org/10.5194/egusphere-egu22-6638
EGU General Assembly 2022

Interpretation of a thermal response test in a Bayesian framework to infer the hydraulic properties surrounding a standing column well

Louis Jacques and Philippe Pasquier
Department of Civil, Geological and Mining Engineering, Polytechnique Montréal, Montréal, Canada
(louis.jacques@polymtl.ca)

The main objective of a thermal response test is to identify the thermal properties near ground heat exchangers. In standing column wells, the groundwater acts as the heat carrier fluid, rending hydraulic and thermal responses strongly related. Consequently, the identification of hydraulic properties through thermal response test is possible. In this study, the Bayesian framework is employed to infer joint and marginal distributions of thermal and hydraulic properties based on the experimental data gather during a 160-hour thermal response test. This test was conducted on a standing column well constructed in a layered aquifer having locally high groundwater velocities. To simulate the thermal response test, a finite element numerical model is first used to generate a training dataset. Then, a neural network is trained to emulate the ground heat exchanger response in fractions of seconds. This strategy accelerates the computation of the Markov chain Monte Carlo slice sampling algorithm. A closed-form expression of the likelihood that takes into account the temporal correlation of the data is also used to obtain additional speedup. Main results indicate an accurate estimation of the hydraulic properties in comparison to results found by complementary experimental pumping tests completed at the same site. In accordance with the high velocities observed while drilling at this particular site, high hydraulic conductivity is obtained at the bottom of the borehole. It was possible to draw robust statistical distributions of hydraulic properties with only a thermal response test, while also assessing the thermal properties and their uncertainties.