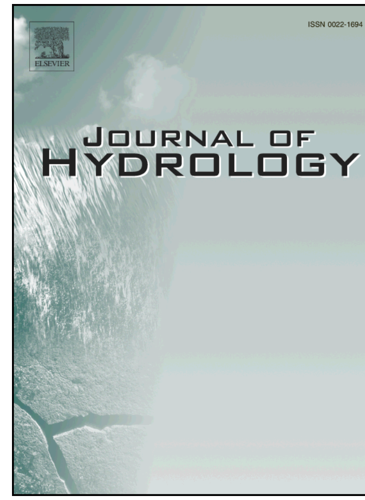

Research papers

Integrating Non-Colocated Well and Geophysical Data to Capture Subsurface Heterogeneity at an Aquifer Recharge and Recovery Site

Ian P. Gottschalk, Thomas Hermans, Rosemary Knight, Jef Caers, David A. Cameron, Julia Regnery, John E. McCray

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Integrating Non-Colocated Well and Geophysical Data to Capture Subsurface Heterogeneity at an Aquifer Recharge and Recovery Site

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Abstract: Geophysical data have proven to be very useful for lithological characterization. However, quantitatively integrating the information gained from acquiring geophysical data generally requires colocated lithological and geophysical data for constructing a rock-physics relationship. In this contribution, the issue of integrating noncolocated geophysical and lithological data is addressed, and the results are applied to simulate groundwater flow in a heterogeneous aquifer in the Prairie Waters Project North Campus aquifer recharge site, Colorado.Two methods of constructing a rock-physics transform between electrical resistivity tomography (ERT) data and lithology measurements are assessed. In the first approach, a maximum likelihood estimation (MLE) is used to fit a bimodal lognormal distribution to horizontal crosssections of the ERT resistivity histogram. In the second approach, a spatial bootstrap is applied to approximate the rock-physics relationship. The rock-physics transforms provide soft data for multiple point statistics (MPS) simulations. Subsurface models are used to run groundwater flow and tracer test simulations. Each model's uncalibrated, predicted breakthrough time is evaluated based on its agreement with measured subsurface travel time values from infiltration basins to selected groundwater recovery wells. We find that incorporating geophysical information into uncalibrated flow models reduces the difference with observed values, as compared to flow models without geophysical information incorporated. The integration of geophysical data also narrows the variance of predicted tracer breakthrough times substantially. Accuracy is highest and variance is lowest in breakthrough predictions generated by the MLE-based rock-physics transform. Calibrating the ensemble of geophysically constrained models would help produce a suite of realistic flow models for predictive purposes at the site. We find that the success of breakthrough predictions is highly sensitive to the definition of the rock-physics transform; it is therefore important to model this transfer function accurately.