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Fully Coupled Hydrogeophysical Inversion of Salt Tracer Experiments

D. Pollock (1) and O. A. Cirpka (2)

(1) Eawag, Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland (davina.pollock@eawag.ch),
(2) Center for Applied Geoscience (ZAG), University of Tübingen, Tübingen, Germany (olaf.cirpka@uni-tuebingen.de)

Electrical resistivity tomography has been used in various studies to monitor salt tracer experiments. We have introduced a new approach to infer the hydraulic conductivity distribution directly from measurements of electrical potential differences during salt tracer tests. This method has the advantage of not having to divide the analysis into two steps (in which the electrical conductivity distribution is obtained first and the hydraulic quantitities are subsequently estimated), which has been mostly done so far. The key point of our analysis lies in the use of temporal moments of electrical potential perturbations resulting from the tracer injection. The set of equations used to obtain the hydraulic conductivity distribution from hydraulic head and electrical potential measurements considers geoelectrics, groundwater flow and solute transport as a coupled system, in order to avoid obtaining results which are in contradiction with the underlying physical laws, e.g. mass conservation. We have now integrated the forward calculation into a fully coupled hydrogeophysical inversion approach, in which the target of the inversion is the hydraulic conductivity field. We applied the quasi-linear geostatistical inversion approach to this problem. We show some results obtained from the geostatistical inversion of synthetic data. Our data simulates hydraulic head and electrical potential measurements during tracer tests in a quasi two-dimensional sandbox; the analysis is therefore restricted to two spatial dimensions. Different electrode configurations are used in the simulations.