ESTIMATION OF AQUIFER TRANSPORT PARAMETERS FROM RESISTIVITY MONITORING DATA WITHIN A COUPLED INVERSION FRAMEWORK

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Despite the fact that electrical resistivity surveys are being increasingly used to image solute migration in porous media, there is limited experience in how these data can be used to characterize aquifer transport parameters. In this study we evaluate whether electrical resistivity monitoring data can constrain the hydraulic conductivity, porosity, and dispersivity of a homogeneous aquifer within the framework of coupled inversion. We focus on responses from a single set of current electrodes to provide insights into the information content of these measurements and motivate future work in designing optimal surveys for monitoring groundwater transport processes. We have found that even in this simple system two distinct types of tradeoffs exist that could confound the direct estimation of transport parameters. First, different values of porosity and hydraulic conductivity can produce the same plume velocity, thereby leading to identical concentration distributions in the subsurface. In ideal cases this hydrologic non-uniqueness can be resolved by electrical data because electrical resistivity is dependent on both solute concentration and porosity, but this discrimination will only possible when the rock physics relationship between concentration and resistivity can be accurately determined. The second type of non-uniqueness occurs when different concentration plumes produce equivalent electrical responses. In this case, tradeoffs between plume velocity and dispersivity cause shifts in the position and mass of solute relative to the electrodes that result in equivalent values of subsurface apparent
resistivity. This non-uniqueness can be overcome by explicitly recognizing that different information about transport processes is captured by the timing versus magnitude of the electrical response in monitoring data. Though we have investigated a homogeneous system, we argue that the insights here can also be applied to the estimation of effective transport parameters for heterogeneous systems.