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Stepwise Approximation of Hydraulic Tomography Surveys for Field-Scale Heterogeneous Aquifers
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Hydraulic tomography surveys (HTS) integrate information of direct measurements and pumping test data to estimate spatial distributions of hydraulic conductivity with higher resolution. To conduct HTS requires a series of cross-well hydraulic tests. Practical applications of HTS are expensive because many packers and pressure transducers are usually used to simultaneously obtain multilevel and isolated head observations for numerical inversions. This study aims to develop a stepwise approximation to estimate multilevel hydraulic test data and apply the approach to a field-scale problem in a confined aquifer located at the campus of the Fooyin University in south Taiwan. The hydraulic stepwise test in field would use least set of packers to separate the well into an interval and obtain the multilevel observations by changing different depths of packers in a pumping stress. This study first conducted numerical investigations that a variety of cases including different variations of hydraulic conductivity (K) such as variance value and correlation length in x direction of K. To assess how and to what degrees the accuracy of the proposed stepwise approximation would compare with original HTS for estimations of aquifer parameters in synthetic heterogeneous aquifers. Base on the stepwise approach this study is then applied to hydraulic tests at well field in the Fooyin University. The numerical assessments show that the higher variance of aquifer properties the lower accuracy. The results of numerical experiments indicate that two types of head observations could yield similar estimations of hydraulic properties in magnitude and patterns. Due to limited packers and pressure transducers, the full version of HTS was not conducted at the well field for comparisons. The results based on stepwise observations from three wells in Fooying University show that the inversion of field test data agrees well with the identification of soil material types from borehole loggings. Additionally, the mean value of the estimated hydraulic conductivity closed to the one from depth?averaged two-dimensional HTS and inversions.

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