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Three-dimensional inversion of field-scale pumping test data for a layered sandy loam aquifer

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Characterization of the aquifer properties based on field test data is often difficult due to insufficient information on sites. The concept hydraulic tomography survey (HTS) is recognized to be an efficient technique to estimate high-resolution aquifer properties such as hydraulic conductivity (K) and storage coefficient (S). This study employs the HTS to integrate the information from direct measurements of aquifer properties and pumping test data to inversely estimate the spatial distributions of K and S in a layered aquifer in Fooyin University in south Taiwan. There are seven well at the site with average depth of 20m. Based on the well loggings, the aquifer materials in the well field are classified as loamy sand above 9m, sandy loam and loamy sand with gravel below 9m, and sandstone rock at the bottom below 19m in average. A series of constant rate pumping test data were obtained from five pumping and observation wells. Base on the concept of HTS, such independent pumping test data were then integrated in the inverse model to estimate the 2D and 3D spatial distributions of K and S. To obtain multilevel head measurements in vertical direction, we used several pneumatic packers in each well to measure head changes with time during a pumping event. In this study the test interval (depth) of the aquifer is 10m, from 9 to 19m below the land surface. Due to limited number of pneumatic packers for the multilevel hydraulic test, no transient head data was measured for 3D simulation. The 2D simulation results show that the K of the aquifer varies from 10^{-2} to 10^{-5} m/s, while the 3D simulation results show that the K varies from 10^{-3} to 10^{-6} m/s. The estimated S distribution by using 2D simulation shows a small variation of S for the well field. Additionally, the estimation results from 3D simulation show a relative high K layer within 11m to 18m below ground surface. Such high K zone can be the fast flow channel that may influence significantly the operation of tracer tests at the well field.