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Comparing the Effects of Estimating Hydraulic Property with Different Boundary Head Conditions using Sequential Pumping Test Method at Field Site

Si-Xian Liu (1), Jyun-Lin Chen (2), Hong-Ru Lin (2), Shao-Yang Huang (3), Tian-Chyi J. Yeh (4), Jet-Chau Wen (3,5)

(1) National Yunlin University of Science and Technology, Graduate School of Safety Health and Environmental Engineering, Yunlin, Taiwan (m10614044@gmail.com), (2) Graduate School of Engineering Science and Technology, National Yunlin University of Science and Technology, Douliou, Yunlin , Taiwan, (3) Research Center for Soil & Water Resources and Natural Disaster Prevention (SWAN), National Yunlin University of Science and Technology, Douliou, Yunlin , Taiwan, (4) Department of Hydrology and Atmospheric Sciences, The University of Arizona, John Harshbarger, Tucson, AZ, (5) Graduate School of Engineering Science and Technology, National Yunlin University of Science and Technology, Douliou, Yunlin , Taiwan

Over the last decades, hydraulic tomography (HT), that is an aquifer test technology has been widely developed and successfully utilized into several field sites in order to delineate the heterogeneous distributions of hydraulic properties. Yet, field uncertainties, such as earthquakes, tides, and boundary effects, may influence hydraulic properties while using HT. Therefore, this study investigated the heterogeneous distributions of hydraulic properties such as the transmissivity (T) and storage coefficient (S) using different initial and boundary head conditions by applying the HT.

This study investigates possible outcomes of boundary conditions by applying HT field data in different numerical models, so to estimate the most effective simulation process for T and S. Specifically, three numerical cases: (1) the constant boundary head conditions; (2) the variable boundary head condition by kriging method; and (3) the variable boundary head condition using the sensitivity equation method (SEM) are compared for estimating the heterogeneous distributions of T and S by using data from the sequential pumping tests at field site. Besides, comparison of predicted heads and observation heads by validation modeling.

According to the results, the hydraulic properties using the variable boundary head condition by SEM can clearly presents the heterogeneous distributions of the site, and using variable head boundary condition estimates hydraulic properties is feasible; therefore, it can be stated that the variable boundary head condition of this model can reduce uncertainties effecting the results. By establishing monitoring wells in field sites of known boundaries and recording long-term groundwater level modifications, real conditions of heterogeneous aquifers can be further defined.

Keywords: Boundary effect, Hydraulic tomography, Sequential pumping test, Heterogeneity