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OPTIMAL ESTIMATION OF HYDRAULIC CONDUCTIVITY AND BOUNDARY CONDITION UNDER STEADY-STATE SIMULATION

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Summary. The first step of aquifer parameter and dependent variable estimation based on hydraulic modeling is generally to choose the best steady-state conditions for the set time period. This situation will occur when the hydraulic head variation for observed wells is at minimum. Therefore, the hydraulic gradient should be constant and mean recharge zero over the study area during the simulation (Graham and Neff, 1994). In this case the system response to the boundary conditions in the aquifer can be elaborated on. The aim of this study was to use and develop a finite-difference groundwater model, MODFLOW 2000 within the GMS software, to define the best parameter estimation and boundary conditions when all residual errors are at minimum for different cases considering accurate confidence intervals and sensitivity analysis. Ten different steady-state conditions were obtained during the given time period with no recharge. These steady-state conditions were simulated and analyzed using the groundwater model for the 6000 ha Gareh-Bygone Plain which is located in arid southern Iran. In this area, a flood water spreading system to artificially recharge the groundwater was established between 1983 and 1987 on about 2000 ha. Four observations wells were used to build the conceptual model for a 14-year period and the model was calibrated with observed hydraulic head at the observation wells. Reliable prediction using the groundwater model occurs when there is a minimum difference between observations and simulations (e.g., Hill, 2006). In all above ten steady-states the average residual error between observed vs. computed hydraulic head was close to zero. Consequently, the confidence interval region for all estimated values was quite narrow and estimated horizontal hydraulic conductivity in all periods and zones varied between 0.0003 and 0.3 m/day. Based on the resulting confidence intervals it appears that results are statistically robust. In addition, the confidence interval for the parameter estimation is a potentially significant factor in the model calibration. Prediction sensitivity illustrates the importance of parameter value for the prediction when used to compare the relative importance of different parameters (Hill and Tiedeman, 2007). Consequently, optimal estimated parameters were selected base on minimum difference between observation and parameter sensitivities and minimum groundwater level changes during successive intervals ($dh \approx 0$). Several different boundary conditions were used in the model calibration to define a reliable boundary condition using sensitivity analysis. In the model calibration, the results show that the model is more sensitive to the time-variant specified-head and general head boundaries than other boundary conditions.