Unbiased Aquifer Modeling Is Achievable Using Geostatistics

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The simulation of groundwater flow and transport requires a thorough understanding of the hydrogeologic characteristics of the site. The hydrogeologic investigation should include a complete characterization of the subsurface extent and thickness of aquifers, hydrologic boundaries, which control the rate and direction of movement of groundwater, hydraulic properties of the aquifers and confining units, and the description of the horizontal and vertical distribution of hydraulic head throughout the modeled area for both initial steady-state and transitional or transient conditions, and distribution and magnitude of groundwater recharge. These models are computer based numerical solutions to the boundary value problems and thus can be summarized in few steps as 'Specified hydrogeological parameters or inputs, given initial and boundary conditions and lastly the solution of the differential equations'. However, the available data is certainly not always sufficient due to variability or the modeler has only a few measurements of head, the results of some pumping tests, and a vague idea of the boundary conditions, leakage, or rates of recharge. Because of this models are calibrated with fewer available data, which would significantly lead to erroneous results and also making aquifer modeling biased.

Groundwater models are simplified, conceptual representations of a part of the hydrologic cycle. They are primarily used for hydrologic prediction (hydraulic head, flow rates and solute concentration) and for understanding hydrologic processes (contaminant migration, solute transport etc.). However, in most regional studies the modeler has to make a large number of decision that are often qualitative and hence are largely affected by the bias of the modeler. Geostatistics, based on theory of regionalized variables has now-a-days found application in almost all the domains of hydrogeology from parameter estimation to predictive modeling for groundwater management. It could be applied at each step of hydrogeological modeling studies viz., from data collection network designing, parameter estimation for fabrication and calibration of aquifer modeling. Kriging, best linear unbiased estimator of the regionalized variables, is a potential tool in increasing the accuracy of model calibration as it provides the best estimates of the system parameters with a measure of confidence (estimation error) that can be used in performing simulations with an ease for the modeler to investigate the model uncertainties. The quantification of errors based on the variability provides

unbiased platform to decision to perform aquifer modeling. A case study has demonstrated practically its applications with clear guidelines for aquifer modeling.