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Exploring Several Methods of Groundwater Model Selection

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Abstract
Selecting reliable models for simulating groundwater flow and solute transport is essential to groundwater resources management and protection. This work is to explore several model selection methods for avoiding over-complex and/or over-parameterized groundwater models. We consider six groundwater flow models with different numbers (6, 10, 10, 13, 13 and 15) of model parameters. These models represent alternative geological interpretations, recharge estimates, and boundary conditions at a study site in Iran. The models were developed with Model Muse, and calibrated against observations of hydraulic head using UCODE. Model selection was conducted by using the following four approaches: (1) Rank the models using their root mean square error (RMSE) obtained after UCODE-based model calibration, (2) Calculate model probability using GLUE method, (3) Evaluate model probability using model selection criteria (AIC, AICc, BIC, and KIC), and (4) Evaluate model weights using the Fuzzy Multi-Criteria-Decision-Making (MCDM) approach. MCDM is based on the fuzzy analytical hierarchy process (AHP) and fuzzy technique for order performance, which is to identify the ideal solution by a gradual expansion from the local to the global scale of model parameters. The KIC and MCDM methods are superior to other methods, as they consider not only the fit between observed and simulated data and the number of parameter, but also uncertainty in model parameters. Considering these factors can prevent from occurring over-complexity and over-parameterization, when selecting the appropriate groundwater flow models. These methods selected, as the best model, one with average complexity (10 parameters) and the best parameter estimation (model 3).