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Abstract This paper proposes a novel stochastic framework for groundwater quantity and quality management in aquifers threatened by saltwater intrusion. In this methodology, a finite difference SEAWAT code is linked with an optimization model to solve density-dependent groundwater flow equations considering different patterns of pumping rates. To reduce the computational time of the simulation–optimization process especially when there are a high number of decision variables, a modular evolutionary polynomial regression (MEPR) model is developed and coupled with the optimization algorithm. The info-gap theory is utilized to evaluate the robustness of optimal scenarios incorporating the uncertainty of hydraulic conductivity (k) of the heterogeneous aquifer. For each management scenario proposed by the simulation–optimization model, values of robustness and opportuneness indices are computed based on utility functions of different agricultural sectors. The results of applying the proposed method to the Qom aquifer in Iran show that coupling MEPR model with the simulation–optimization model considering the uncertainty of the aquifer parameter k could provide a reliable management scenario with a comparatively low computational cost.

Keywords Saltwater intrusion Info-gap theory Deep uncertainty Qom aquifer Evolutionary polynomial regression