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Modelling and Calibration of Groundwater Flow in Qatar Karst Aquifer

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Groundwater models are useful for understanding groundwater flow and solute transport, which enable proper management of water recourse. However, calibration of regional groundwater models is not easy due to the high number of variables involved and the associated computational expenses.
This paper discusses the development of a regional scale groundwater flow model for the entire country of Qatar, with emphasis on calibration process. The aquifer in Qatar is the only source of natural water so it is important to understand the flow regime to protect the aquifer. Modelling groundwater flow of Qatar aquifer is challenging as the aquifer is karst with lots of conduits and fractures so it is highly heterogeneous. The aquifer media comprises mainly three geological formations of limestone and dolomite with variable degrees of fractures and confinement. The model comprises 243360 cells and three layers representing the three geological formations. The inverse modelling tool "PEST" was used to calibrate the model using pilot points and regularization to reduce the computational expenses. The hydraulic conductivity and recharge values were calibrated against the target groundwater levels of the pre-development in 1958, which were assumed to represent the steady state conditions. Model results show groundwater recharge is about 65 million m3 per year, mainly concentrated in the northern area of the country. Hydraulic conductivity was found to be highly variable with values range between 0.1 m/d and 200 m/d. This highlights the need to consider dual porosity modelling and compare the results with this model.

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