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Identifying anthropogenic effects into Doñana aquifer (SW Spain) through hydrogram clustering of piezometric database

Carolina Guardiola-Albert, Nuria Naranjo-Fernández, Héctor Aguilera, and Esperanza Montero-González

Spanish Geological Survey, Madrid, Spain (c.guardiola@igme.es)

Nowadays, the application of time series clustering is increasing in hydrogeology works. Groundwater level long data series provides a useful record to identify different hydrological behaviors and to validate the conceptual model of groundwater flow in aquifer systems. Piezometers also register the response to any changes that directly affect the amount of available groundwater resources (recharge or exploitation).

What are the expected variations of groundwater levels in an aquifer under high exploitation pressure? In this work, groundwater level time series from 160 piezometers in the hydrological years from 1975 to 2016 were analyzed. Especially, 24 piezometers are deeply studied. Data were preprocessed and transformed: selection of points, missing data imputation and data standardization. Visual clustering, k-means clustering and time series clustering were applied to classify groundwater level hydrographs using the available database. Six and seven groups of piezometers were identified to be associated with the different hydrofacies and extraction rates. Time series clustering was found to be the best method to analyze the studied piezometric database. Moreover, it was possible to characterize actual hydrodynamics, which will be useful for groundwater managers to make sustainable decisions.