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A hybrid clustering and ANNs for investigating the impacts and mechanisms of various temporal and spatial scales of surface water to groundwater variation

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In this study, we propose Artificial Intelligent Technologies (AI) to investigate the impacts and mechanisms of various temporal scales of surface water to groundwater for the Zhuoshui River basin in southern Taiwan. Based on the collected long-term hydrogeological data sets, the aims of this study are (1) establishing the interaction relationships between various temporal-spatial scales of surface water with groundwater level variation and (2) constructing regional intelligent groundwater level prediction models. The analysis results can provide valuable information for the prevention and treatment of land subsidence and the water resources management. Firstly, three different clustering methods, the self-organization map (SOM), fuzzy K-mean clustering (FKM), and support vector machine (SVM) have been implemented for investigating the temporal-spatial variation characteristics of groundwater. The interaction between surface hydrological factors and groundwater level variations in various temporal scales (i.e. day, ten-day, month) and spatial scales (i.e. layers and regions) are fully investigated and the temporal-spatial characteristics of clustered results are compared and presented. Secondly, we proposed the different hybrid forecast models, which include various clustering model (from the above clustering models) and dynamic or static neural networks, to predict groundwater level and to investigate the interaction between surface water and groundwater. The dynamic neural network is the nonlinear autoregressive network with exogenous inputs (NARX/R-NARX), and the static neural networks are the adaptive network-based fuzzy inference system (ANFIS) and support vector regression (SVR). The results show that NARX has the best performance and superior robustness. The NARX is low sensitive to the amount of input information, while the ANFIS and SVR models are high sensitive to inputs.