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A Comparative Study of Long-term Groundwater Level Prediction using ANN, SVM and ANFIS based on EEMD

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Reliable and accurate estimation of groundwater level fluctuations is essential for managing water resources to improve water-use efficiency. Three nonlinear time-series intelligence hybrid models, artificial neural networks (ANN), support vector machines (SVM) and adaptive neuro fuzzy inference system (ANFIS) coupled with ensemble empirical mode decomposition (EEMD) was proposed to forecast groundwater level fluctuations. The validity and applicability of these three hybrid models, EEMD-ANN, EEMD-SVM, and EEMD-ANFIS was investigated using two groundwater level time series near Lake Okeechobee in Florida. 16 years data-sets including hydrological and hydrogeological parameters such as precipitation, temperature (maximum, mean and minimum), past groundwater level and lake level were used as input data to predict groundwater level by ANN, SVM and ANFIS. The results from EEMD-ANN, EEMD-SVM and EEMD-ANFIS models were analyzed and compared with the results from ANN, SVM and ANFIS models. The performances of these models were evaluated using five statistical performance evaluation measures, including the Correlation Coefficient (R), Normalized Mean Square Error (NMSE), Root Mean Squared Error (RMSE), Nash-Sutcliffe efficiency coefficient (NS), Akaike Information Criteria (AIC). These three hybrid models, EEMD-ANN, EEMD-SVM, and EEMD-ANFIS models were proved applicable to the prediction of groundwater level for the area that is close to the lake area. The results from EEMD-ANFIS and EEMD-SVM models were more accurate than that from EEMD-ANN model. At the same time, the models using EEMD-ANFIS, EEMD-SVM and EEMD-ANN achieved better prediction result than that using ANFIS, SVM and ANN. The conclusions achieved from this research indicated that the proposed hybrid models can improved the performance in predicting groundwater level, which would be beneficial to the sustainable water resources management.