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Streamflow predictions in Alpine Catchments by using artificial neural networks. Application in the Alto Genil Basin (South Spain)

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This study explores techniques of modeling water inflow series, focusing on techniques of short-term steamflow prediction. An appropriate estimation of streamflow in advance is necessary to anticipate measures to mitigate the impacts and risks related to drought conditions. This study analyzes the prediction of future streamflow of nineteen subbasins in the Alto-Genil basin in Granada (Southeast of Spain). Some of these basin streamflow have an important component of snowmelt due to part of the system is located in Sierra Nevada Mountain Range, the highest mountain of continental Spain. Streamflow prediction models have been calibrated using time series of historical natural streamflows. The available streamflow measurements have been downloaded from several public data sources. These original data have been preprocessed to turn them to the original natural regime, removing the anthropic effects. The missing values in the adopted horizon period to calibrate the prediction models have been estimated by using a Temez hydrological balance model, approaching the snowmelt processes with a hybrid degree day method. In the experimentation, ARIMA models are used as baseline method, and recurrent neural networks ELMAN and nonlinear autoregressive neural network (NAR) to test if the prediction accuracy can be improved. After performing the multiple experiments with these models, non-parametric statistical tests are applied to select the best of these techniques. In the experiments carried out with ARIMA, it is concluded that ARIMA models are not adequate in this case study due to the existence of a nonlinear component that cannot be modeled. Secondly, ELMAN and NAR neural networks with multi-start training is performed with each network structure to deal with the local optimum problem, since in neural network training there is a very strong dependence on the initial weights of the network. The obtained results suggest that both neural networks are efficient for the short term prediction, surpassing the limitations of the ARIMA models and, in general, the experiments showed that NAR networks are the ones with the greatest generalization capability. Therefore, NAR networks are chosen as the starting point for other works, in which we study the streamflow predictions incorporating exogenous variables (as the Snow Cover Area), the sensitivity of the prediction to the initial conditions, multivariate streamflow predictions considering the spatial correlation between the sub-basins streamflow and the synthetic generations to assess droughts statistic.

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