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Cluster-based streamflow prediction using genetic algorithm-trained neural networks

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Predicting streamflows helps improve planning and operation of hydro-systems, mitigation of floods and droughts damage, and planning and management of water resources in general. Most of the hydrological processes show high nonlinearity both in spatial and temporal domains. Traditionally, regression and auto regressive moving average (ARMA) models have been widely used to model streamflow. But recently, artificial neural networks (ANNs) have been shown to be a promising alternative in modeling the nonlinear runoff due to their universal approximation property. However, there are cases when ANNs were not able to predict flow extremes (low and high flows). In more general sense, ANNs did not perform well when the data are clustered. In this study, a methodology for cluster-based streamflow prediction is proposed based on genetic algorithm (GA)-trained ANNs.

Cross-correlated streamflow data are considered in this study. The monthly flows of the Reed Creek, VA, U.S.A. (*target* river) are predicted based on the flows of Little River, VA, U.S.A. (*reference* river). The entire dataset between October 1928 and September 2003 is divided into three experiments: E1 (Oct. 1928 – Sept. 1953), E2 (Oct. 1953 – Sept. 1978), and E3 (Oct. 1978 – Sept. 2003). Each experiment involves 300 instances, out of which 250 instances are used for training and the remaining 50 instances are used for testing the model.

The performance of cluster-based model is compared with regular ANN models that use Bayesian regularization back propagation and Levenberg-Marquadart algorithms for training the networks. From the study, it is found that the proposed cluster-based model performed better than the conventional algorithms in terms of minimizing the

prediction error. Classification correctness of the clustering algorithm is also investigated. Improvement in the accuracy of clustering is shown to improve the prediction accuracy of the overall performance of the cluster-based GA-trained ANN model.