Estimation of the monthly average discharge based on Artificial Neural Network (A case study; Talar and Kasilian watersheds)

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ABSTRACT

Over the past 15 years, artificial neural networks (ANNs) have been used increasingly for prediction and forecasting in water resources and environmental engineering. However, despite this high level of research activity, methods for developing ANN models are not yet well established. To obtain a snapshot of current practice, ANN development methods are assessed based on the taxonomies for journal papers that were published from 1999 to 2007 and focus on the prediction of water resource variables in river systems and also flow discharges. Artificial Neural Network is one of the intelligence and flexible techniques for any complex processes which is able to recognize the relation between input and output. Estimation of the monthly average discharge is one of the main challenges encountered in water, river engineering and also has a basic role in planning, management, sustainable and optimal operation. There are various parameters affecting the input discharge value. They are not fully known, and their relationship with input discharge is so complex. Thus, giving mathematical relationship of this concern is difficult. Spatial and temporal characteristics which influence discharge of the rivers clarify the complicacy of relations. Artificial Neural Networks have high ability to overcome this complexity and due to their properties, they can simulate complicated relations. In this study ANN model was employed for average discharge estimation in Talar and Kasilian Rivers in the Northern flank of Alborz, Iran. Also two hydrometric stations, one evaporimeter station and one gauging station were chosen. The statistical period for this study was about 15 years. To test the homogeneity of data Double-mass curve method was applied. Before entering the input data to the model they were separated to three parts: Training, Validation and Test data. To design the network in model, Cross Validation method has been used. Also it was attempted to design multi-layer Perceptron with Back Propagation learning rule for recovering the non-linear relationship between dependent and independent variables. Although multilayer perceptron is still the most popular model architecture, other model architectures are also used extensively. Application of this relation would be resulted in prediction of monthly average input discharge in stream. For validation of the proposed model the gained results from Artificial Neural Network model were compared with the field measurements. In relation to model calibration, gradient based methods are used almost exclusively. The results from the study showed that there is an acceptable overlapping between predicted values from Artificial Neural Networks and observed data, with root mean square error (RMSE) of 0.0122. Finally, results specified that ANN is a suitable method for monthly discharge estimation in the selected watershed with these networks being also of the capability to confirm basin response to spatial and temporal characteristics.

Keywords: Discharge, ANN, Kasilian and Talar watersheds, Iran.