Estimation Of Discharge of Baranduzchay River Using Artificial Neural Networks

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Abstract

Flow estimation in rivers, provides important information on a wide range of problems that used for design, management and operation of water resources such as river systems, and dams. The application of artificial neural networks (ANNs) to various aspects of hydrological modeling has undergone much investigation in recent years. The present study aims to utilize an Artificial Neural Network (ANN) to modeling the discharge and precipitation relationship in a river located in Iran. This study also presents the application and comparison of artificial neural networks (ANN) and Multi Linear Regression (MLR) to predict the daily flow discharge of the Baranduzchay River in Iran. The Hashem Abad station of Baranduzchay was considered. The data used in this study are daily discharge and daily precipitation of Hashem Abad station. Three types of artificial neural networks models were used in this study. The estimation methods are Feed Forward Back Propagation (FFBP), Radial Basis Function (RBF) and Generalized Regression (GRNN). Also, Multi Linear Regression (MLR) model was developed using the same input parameters for discharge estimation. The results of ANN and MLR models were compared with measured discharge values to evaluate performance of the developed models. Results of all methods were compared and shown in tables and charts. The results extracted from the comparative study indicated that the artificial neural network method is more appropriate and efficient to predict the river discharge than classical regression model.

Keywords: Artificial Neural Network, Multi Linear Regression, Hashem Abad, Estimation

1. Introduction

Water is one of the essential commodities, which is available cheaply as a natural resource. Rainfall is a major component of the water cycle and is responsible for depositing most of the fresh water on the Earth. Thus, amount of rainfall and its effect on runoff is important. Rainfall-runoff models play an important role in water resource management planning. Rainfall prediction and flow estimation, as one of the climatic parameters in the field of water resources management, are particularly important subjects in order to optimization of costs and use of this resource. Accurate predictions of stream flow and, consequently, accurate flood forecasts with sufficient lead time are of great importance for protecting vulnerable areas and reducing flood damages. Nowadays, researchers and scientists are trying to find ways to more accurately predictions of hydrological parameters. These efforts have led to find and advancement of sciences such as intelligent methods.

Artificial neural networks are an artificial intelligence component. Use of this modeling is increasing rapidly in prediction and forecasting variables in water resources engineering. Artificial neural networks (ANN) method is used commonly in the modeling of non-linear system behavior. This method is derived from the researches on the nature of the human brain. The artificial neural networks have substantially abilities and these models require less computational effort and input in comparison with conventional models.

There are numerous applications of ANNs in water resources. Cigizoglu (2002) used ANNs in rainfall forecasting based on the previous rainfall observations. Tokar & Johnson (1999), Hu et al. (2001) and Cigizoglu (2002) employed neural network methodology for the river runoff forecasting. Artificial neural networks were also considered as a powerful tool to use in various groundwater problems (Ranjithan et al., 1993), Generalized regression neural networks in daily river flow forecasting (Cigizoglu , 2003). Altun et al. (2007) investigated the effect of the skewness on the estimation of the suspended sediment by ANN. Kisi (2005) investigated the abilities of neuro-fuzzy and neural network approaches to model the daily stream flow-suspended sediment load. Other applications of ANNs include unit hydrograph derivation (Lange, 1998), regional flood frequency analysis (Hall & Minns, 1998), estimation of sanitary