Multi-temporal Scale Flood Prediction using Artificial Neural Networks: A Case Study for Devils Lake and Red River of the North Basins[1]

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Abstract

Flood predictions are required to provide basic information for floodplain management. Limitations of runoff models to accurately predict floods due to the non-linearity of rainfall-runoff process and the complex nature of hydroclimatological processes make them less desirable for some applications. Black box models such as the artificial neural network (ANN) provide a mathematically flexible structure to identify complex non-linear relationship between inputs and outputs without attempting to explain the nature of the phenomena. A multilayer perceptron ANN technique with an error back propagation algorithm was applied to multi-time scale prediction of the stage of a hydrologically closed lake, Devils Lake (DL) and discharge of Red River of the North at Grand Forks station (RR-GF) in North Dakota. The modeling exercise used 1 year (2002), 5 year (1998-2002), and 27 year (1975-2002) hydrometeorological data for the daily, weekly and monthly predictions, respectively, for both basins with portion of data for training (calibration) and the remaining for testing (verification). Implementation of the model using antecedent precipitation, stage/discharge in addition to current precipitation and air temperature improved the prediction. Comparison of the model output with the observed values showed an overall average testing prediction efficiency of 87% and 80% for DL and RR-GF basins respectively.

(Key terms: Artificial neural network, Devils Lake, Red River, flood, prediction)

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