Application of Artificial Neural Network to Forecast Monthly Discharges of the Bilate River

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While conceptual models are important to understand hydrologic processes, in many practical situations, such as stream flow forecasting, the main concern is to make accurate predictions at specific watershed locations. In that case, a hydrologist may prefer not to expend the time and effort required to develop and implement a conceptual model and instead implement a simpler system-theoretic model. This paper demonstrates the applicability of the systems theoretic Artificial Neural Network (ANN) approach in developing nonlinear models of the rainfall-evapotranspiration-runoff process without the need to explicitly represent the internal hydrologic structure of the watershed. The study area concentrates on the Bilate sub-basin (at Alaba Kulito), a tributary to Lake Abaya.

This ANN is a multilayer perceptron (MLP) feed forward network with the hyperbolic tangent function as the transfer function. The network weights were adjusted during the calibration or training process through minimization of the mean square error (MSE) using the error back-propagation algorithm. The results show that the MLP predicts stream flow at Alaba Kulito better than the generalized feed forward (GFF) algorithm. However, the conceptual monthly water balance model (MOWBAL) outperforms both.

While the ANN model is not intended as a substitute for a physically-based conceptual model, it can provide a viable alternative when the hydrologic application requires that an accurate forecast of stream flow behaviour be provided using only the available input and output time series data, and with relatively little conceptual understanding of the hydrologic dynamics of the watershed under investigation.