



Application of ANN for Daily Streamflow Prediction

The physically-based hydrological models require a large number of input data and parameters. This research evaluates the performance of a much simpler artificial neural network (ANN) model for predicting streamflow and water quality at the watershed level.

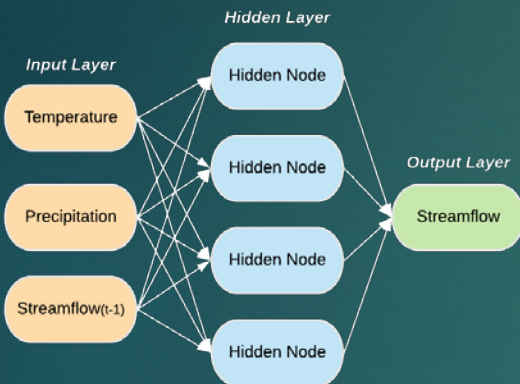


Fig. 1. The structure of a 3-layer feed-forward ANN

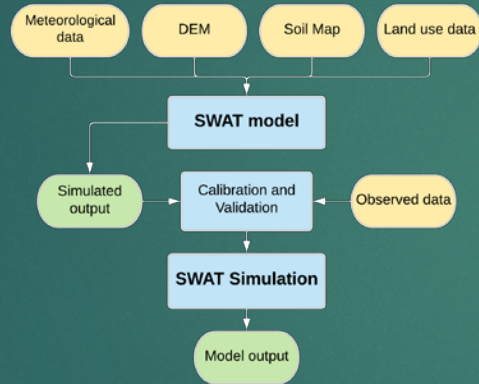


Fig. 2. General methodology of using the SWAT model

The Wilmot River Watershed is a 61 km² agricultural watershed located in Prince Edward Island. Weather and stream discharge, water quality data are available for the years 2011 to 2017 from Environment Canada and Climate Change Canada.

Various temporal and spatial data were used as input parameters to the Soil and Water Assessment Tool (SWAT) model. Model calibration was performed to account for uncertainties using the SWAT-CUP package. Fig. 1 depicts model structure and key inputs.

	Calibration		Validation	
	SWAT	ANN	SWAT	ANN
PBIAS	-16%	5.7%	-6.3%	9.5%
R2	0.6	0.77	0.47	0.46
NSE	0.59	0.77	0.47	0.46

Table 1. Performance indicators of ANN and SWAT models

The ANN used for this study was a three-layer feed-forward back propagation (FFBP) network with sigmoid and linear activation functions in the hidden layer and in the output layer respectively. Precipitation, temperature, and previous days streamflow were the input parameters used in this model. The model structure is shown in Fig. 4. The model performance was evaluated using indicators of root mean square error (RMSE), percentage bias (PBIAS), coefficient of determination (R^2), and Nash-Sutcliffe efficiency (NSE).

The results achieved by the ANN model (Table 1) were promising. The results could improve through finding optimal input and hyper parameter combinations using a comprehensive grid search approach. Moreover, a geospatial-ANN model will be developed to include spatial data (e.g. land use) in the model.

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