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Application of neural networks in watersheds with dynamic contributing areas

E. Ehsanzadeh (1) and C. Spence (2)

(1) Ilam University, Ilam, Islamic Republic Of Iran (eehsanzadeh@gmail.com), (2) Environment Canada, National Hydrology Research Centre, Saskatoon, SK Canada (Chris.Spence@ec.gc.ca)

Runoff responses to precipitation in the North American Prairies are highly nonlinear due to the seasonality of precipitation, the presence of frozen ground and large variation in contributing area with antecedent moisture condition. This study attempts to evaluate the ability of artificial neural networks (ANN's) to characterize this complex relationship. The performance of a number of Dynamic Neural Networks (DNN's) with diverse memory properties were evaluated and compared with a memoryless static network known as standard multi-layer perceptron (MLP). It was found that the static network which provides no hint to memory in the system was not capable of simulating the precipitation-runoff relationship in this landscape where antecedent moisture condition can introduce significant memory into the runoff generation system. The results show that DNN's with implicit and/or explicit memory properties are reliable alternatives to characterise response behaviour of Prairie landscapes. The performance of the employed networks was impacted by the nonstationarity of the steamflow data and the DNN's were sensitive to the percentage of the drainage area which contributes runoff to the outlet of the watershed.