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Evaluating the Performance of Neural Networks in Modeling Soil Moisture

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An accurate estimate of soil moisture is vital for modeling the water-balance of any hydrological system. However, soil moisture is characterized by large variability in both spatial and temporal scales. In this study, the utility of neural networks in modeling the soil moisture at three reconstructed watersheds, located in northern Alberta, Canada is investigated. The reconstructed watersheds consist of a thin layer of peat overlaying a secondary layer of till. The soil moisture content at both layers is modeled as a function of precipitation, net radiation, air temperature, and ground temperature at peat and till layers. Neural network models with different input combinations were evaluated, and the regressions between the measured and the simulated soil moisture indicates that the models were able to account for only a moderate proportion of the variability in the soil moisture data. However, the results are encouraging considering the large variance existing between the independent and the dependent variables. Ground temperatures of peat and till layers were found to be the effective inputs in characterizing the soil moisture. This study also investigated the utility of higher-order neural networks (HONNs) models in modeling soil moisture. Compared to the traditional neural network models, significant improvement in the correlations between the measured and the simulated soil moisture were achieved by the HONNs. The success of the HONNs in characterizing the soil moisture may be attributed to its ability to exploit self and cross correlations among different input variables.