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Estimating Saturated Hydraulic Conductivity from Soil Water Retention Curve using Neural Networks

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Study of soil hydraulic properties like saturated and unsaturated hydraulic conductivity is required in the environmental investigations. Since, direct measurement of soil hydraulic properties is time consuming and expensive, indirect methods such as pedotransfer function and artificial neural networks (ANN) have been developed based on the readily available soil characteristics. In this study, we used soil water retention data i.e. fractal dimension, air entry value and effective porosity, as well as bulk density and developed artificial neural networks in order to estimate saturated hydraulic conductivity. Total of 142 soil samples of the UNSODA, GRIZZLY and Puckett et al. (1985) databases was divided into two groups as 114 for the development and 28 for the validation of ANN model. We used multi-layer perceptron model with 4 layers as the inputs and one layer as the output of ANN model and back propagation algorithm for training procedure. The activation function was selected LOGSIG in the middle and exist layers. The values of statistical parameters such as coefficient of determination (R2) and mean square error (MSE) showed that the best number of neurons in the middle layer of ANN model was 24. We also compared the developed ANN model with Rawls et al. (1993) and Rawls et al. (1998) models using 28 soil samples. The results showed that developed ANN model estimates saturated hydraulic conductivity better than the other methods. The AIC values of ANN, Rawls et al. (1993) and Rawls et al. (1998) were obtained 291.8, 322.3 and 316.4, respectively.