Improving Pedotransfer (Ptfs) Functions Using Recursive Feature Elimination and Random Forest for Predicting Soil Saturated Hydraulic Conductivity[1]

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Abstract: Pedotransfer functions (PTFs) are alternatives to direct methods for acquiring soil hydraulic properties. PTFs are commonly developed using basic soil physical and chemical properties. In some instances, input variables (such as topographic factors) and more advanced algorithms (machine learning) are applied to augment PTF performance. However, there are few studies focused on how to choose optimal variable combination to improve the interpretability of models. In this study, we used 128 saturated soil hydraulic conductivity (Ks) measurements from northern China, to develop a range of PTFs based on different inputs and algorithms (random forest and artificial neural network) to estimate Ks. The recursive feature elimination (RFE) method was used to filter for optimal combination of variables. Variable importance and partial dependence plots based on random forest were used to reveal relationships between Ks and input variables. We evaluated performance of new PTFs using the determination coefficient (R^2), root mean square error (RMSE) and mean prediction error (ME). The results showed that including topographic factors as additional inputs improved performance of PTFs for estimating Ks. Compared to PTFs that used basic soil properties (BD, clay, silt and sand content) as inputs, the R^2 of PTFs, selected by RFE, increased by 9% for random forest (RF) and 12% for artificial neural network (ANN) respectively and RMSE decreased by 9% for RF and 8% for ANN. The PTFs considering all factors (soil basic properties and topographic factors) without feature selection obtained the poorest results. These results illustrate the potential of RFE and RF to improve performance of PTFs in estimating Ks.

Additional Key Words: Random Forest, Recursive Feature Elimination, Partial Dependence Plot, Topographic Factor

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