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Using Complete Soil Particle Size Distributions for More Precise Predictions of Soil Physical and Hydraulic Properties

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Abstract : The soil particle-size distribution (PSD) is known to affect a broad range of soil physical, mechanical and hydraulic properties. Complete descriptions of a PSD curve should provide more information about these properties as opposed to having only information about soil textural class or the soil sand, silt and clay (SSC) fractions. We compared the accuracy of 19 different models of the cumulative PSD in terms of fitting observed data from a large number of Iranian soils. Parameters of the six most promising models were correlated with measured values of the field saturated hydraulic conductivity (Kfs), the mean weight diameter of soil aggregates (MWD), bulk density (ρb), and porosity (□). These same soil properties were correlated also with conventional PSD parameters (SSC fractions), selected geometric PSD parameters (notably the mean diameter dg and its standard deviation σg), and several other PSD parameters (D50 and D60). The objective was to find the best predictions of several soil physical quality indices and the soil hydraulic properties. Neither SSC nor dg, σg, D50 and D60 were found to have a significant correlation with both Kfs or logKfs, However, the parameters of several cumulative PSD models showed statistically significant correlation with Kfs and/or logKfs ($|r| = 0.42$ to 0.65; $p \leq 0.05$). The correlation between MWD and the model parameters was generally also higher than either with SSC fraction and dg, or with D50 and D60. Porosity (□) and the bulk density (ρb) also showed significant correlation with several PSD model parameters, with ρb additionally correlating significantly with various geometric (dg), mechanical (D50 and D60), and agronomic (clay and sand) representations of the PSD. The fitted parameters of selected PSD models furthermore showed statistically significant correlations with Kfs,, MWD and soil porosity, which may be viewed as soil quality indices. Results of this study are promising for developing more accurate pedotransfer functions.

Keywords : particle size distribution, soil texture, hydraulic conductivity, pedotransfer functions
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