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Predicting the soil moisture characteristic curve from particle size distribution with a simple physical model

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Indirect methods for predicting the Soil Moisture Characteristic curve (SMC) from the Particle Size Density function (PSD) often rely on empirical coefficients which limit their application. We present in this paper a robust simple PSD based physical SMC prediction model and evaluate the model performance through comparisons with the Haverkamp and Parlange(1986) (HP) and Arya and Paris (1981) (AP) prediction models. Following the Arya and Paris (1981) model, we divide the PSD into n size fractions where each fraction contains spherical particles which can pack in different states. The moisture content is subsequently calculated from the PSD and measured saturated moisture content. The packing state is estimated from particle and bulk densities. The suction head is predicted based on particle size, assuming a linear relationship between the suction head and packing state. Results show that the model can adequately predict the SMC as measured in eighty soils selected from UNSODA database. It is also shown that the proposed model provides better predictions of SMC than the AP or HP models. The model underestimates the moisture content in the dry range of the SMC. We attribute this bias to the incomplete desorption of residual water coated on soil particles or water retained within nonspherical particles with high surface energy contents. We conclude that the main advantage of our model is the robustness and independency of model performance on soil type, allowing to improve predictions of SMC from PSD at the larger watershed scales.