Assessment of model consistency for determination of soil–water characteristic curves

Abstract

Characterization of the engineering behavior of unsaturated soil is dependent on the soil–water characteristic curve (SWCC), a graphical representation of the relationship between water content or degree of saturation and soil suction. A reasonable description of the SWCC is thus important for the accurate prediction of unsaturated soil parameters. The measurement procedure for determining the SWCC, however, is difficult, expensive, and time-consuming. During the past few decades, researchers have laid a major focus on developing empirical equations for predicting the SWCC, with a large number of empirical models suggested. One of the most crucial questions is how precisely existing equations can represent the SWCC. As different models have different ranges of capability, it is essential to evaluate the precision of the SWCC models used for each particular soil type for better SWCC estimation. It is expected that better estimation of SWCC would be achieved via a thorough statistical consistency analysis of its applicability within a particular soil class. This paper evaluates the consistency and applicability of using four different SWCC equations for defining the relationship between water content and soil suction. Optimization techniques were used to obtain the best fit of the model parameters for three main soil classes: coarse-textured (i.e., sand), medium-textured (i.e., silt), and fine-textured (i.e., clay) soils. The four SWCC models were evaluated and computed for each sample. The results show that the Brooks and Corey model and modified Gardner model was the most consistent in describing the SWCC for sand soils and clay soils, respectively. Both model predictions also exhibit compatibility with samples ranging from low to high soil water content.