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An attempt to connect soil structure, shrinkage, cracking, and hydraulic properties without the need for fitted parameters

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All available models of soil shrinkage, cracking, and hydraulic properties, despite their essential differences, are based on fitting the model parameters. We try to construct a model that enables one to predict the properties based on soil structure and physical parameters; that is, parameters that can be measured or calculated without fitting, independently of an experimental shrinkage curve, soil water retention curve, or hydraulic conductivity function. Except for the use of the physical parameters there are two major differences between the approach to be suggested and the existing ones. The former is a description of every property (e.g., shrinkage) for successive increasingly complex soil structures starting from a pure clay matrix to a clay with sand grains, to aggregates consisting of the clay with the grains, but not for a soil of arbitrary structure. The latter is an accounting for a number of simple physical conditions (relating to both the micro- and macrostructure of soil) that so far have not been taken into account. Essentially, the physical conditions and corresponding information about soil allow one to use only the physical parameters. These conditions determine the size and shape distributions of pores and solids, the shrinkage and soil water retention curves of different soil structure, the distributions connected with a crack network, and the hydraulic conductivity of a soil matrix and crack network. The presentation gives a review of the approach including main assumptions, recent and current results, and comparison between the latter and available data as well as issues that should be addressed in the future.