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Estimating soil water retention using soil component additivity model

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Soil water retention is a major soil hydraulic property that governs soil functioning in ecosystems and greatly affects soil management. Data on soil water retention are used in research and applications in hydrology, agronomy, meteorology, ecology, environmental protection, and many other soil-related fields.

Soil organic matter content and composition affect both soil structure and adsorption properties; therefore water retention may be affected by changes in soil organic matter that occur because of both climate change and modifications of management practices. Thus, effects of organic matter on soil water retention should be understood and quantified.

Measurement of soil water retention is relatively time-consuming, and become impractical when soil hydrologic estimates are needed for large areas. One approach to soil water retention estimation from readily available data is based on the hypothesis that soil water retention may be estimated as an additive function obtained by summing up water retention of pore subspaces associated with soil textural and/or structural components and organic matter.
The additivity model and was tested with 550 soil samples from the international database UNSODA and 2667 soil samples from the European database HYPRES containing all textural soil classes after USDA soil texture classification. The root mean square errors (RMSEs) of the volumetric water content estimates for UNSODA vary from 0.021 m3m-3 for coarse sandy loam to 0.075 m3m-3 for sandy clay. Obtained RMSEs are at the lower end of the RMSE range for regression-based water retention estimates found in literature. Including retention estimates of organic matter significantly improved RMSEs. The attained accuracy warrants testing the 'additivity' model with additional soil data and improving this model to accommodate various types of soil structure.

Keywords: soil water retention, soil components, additive model, soil texture, organic matter.