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Scaling soil water retention functions using particle-size distribution

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The application of spatially distributed hydrological model is a challenging problem, particularly because of the difficulties arising in the identification of the model parameters describing the soil hydraulic properties and their spatial variability. Generally soil data are available just for a limited number of locations across the study area and very often the available data consist of soil physical and chemical properties rather than direct measurements of the soil hydraulic properties. Thus indirect methods are often required for an assessment of model parameters describing the soil hydraulic properties, based on a limited number of measurements.

This study presents a methodology for assessing the variability of soil water retention from soil texture and bulk density measurements, based on a combination of the scaling approach proposed by Kosugi and Hopmans (1998) and the Arya-Paris (AP) physico-empirical pedotransfer function. The approach proposed by Kosugi and Hopmans (1998) represents the spatial variability of soil hydraulic properties by scaling factors which relate the soil hydraulic functions in any location to a single reference function, provided that soils are characterised by geometric similitude within the study area. The Arya-Paris (AP) physico-empirical pedotransfer function estimates the soil water retention from the soil particle-size distribution and bulk density.

The proposed method has been evaluated in two different areas of Southern Italy. Laboratory-measured and AP-predicted reference water retention functions are compared by evaluating the lognormal distributions of the corresponding scaling factors. The method proved to be effective even with a limited number of soil samples (30-40 soil samples), provided that the study region is classified according to homogeneous soil textural classes, to ensure the geometric similitude within each soil sample set. This method can be potentially used as an effective tool for identifying homogeneous soil hydrologic response units at the catchment scale.