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Influence of selected methods for estimating water retention parameters on the evaluation of soil water content with simulation models

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The Brooks and Corey (B&C) equation estimates soil water retention by means of the following parameters: air entry value, pore-size distribution index, water content at saturation and residual water content. The MACRO model simulates water flow in soil micropores using the B&C-estimated parameter values. The aim of our study was to evaluate the effect of applying different methods for the estimation of these parameters on the results of simulation of soil water content and soil water flow with the MACRO model.

The parameter estimation methods differed depending on the source of the retention curve data needed for fitting the B&C model. Data was obtained from: (i) water retention measurements; (ii) pedotransfer functions (PTFs) found in international scientific literature, relating water retention to soil texture and organic C content; and (iii) PTFs specifically calibrated for the soils of the Po Valley. The information needed was extracted from the Soil Survey Service database of the Emilia-Romagna region. Parameter values generated on the basis of these different water-retention data sources were used as inputs in simulations with the MACRO model. Measured and simulated water contents in 5 soils of the western Emilia-Romagna plain were then compared, for different cropping systems. The considered soils belong to the following textural classes: coarse loam, clay, silt loam, and silty clay (2 out of 5 soils).

Model efficiency was found to be dependent more on differences in hydrological properties among soils than on differences in methods used for estimating the hydrological parameter values. Model efficiency in simulating soil water content was higher for the

fine-textured soils, and lower for the coarse, gravel-containing, soil. The PTFs calibrated for the soils of the Po Valley produced the highest model efficiency, for any given soil. Even if, for a given soil, the method of estimation of the water retention parameters affected the simulated soil water content values only to a limited extent, it had a remarkable influence on the simulation of water percolation and runoff.

We conclude that different methods for water-retention parameter evaluation, while not affecting the simulation of soil water content, do influence the model simulation results. Thus, when the evaluation of the ability of hydrological models to simulate soil water flow is based on their efficiency in simulating soil water content, incorrect conclusions may be drawn.