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Functional evaluation of the field capacity concept for water balance analysis under climatic seasonality conditions

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Some types of hydrologic models, such as the bucket model, rely on the concept of field water capacity, FWC. In this study, the techniques traditionally proposed for determining this parameter have been critically analyzed in terms of their effectiveness in computing soil water budget. Two basic aspects of the problem will be presented: (i) to set up techniques for a suitable parameterization of hydrologic models, (ii) to implement simulation models that describe the various processes with different levels of complexity and compare their results. The following models are considered: the Richards equation based model and the simplified bucket-type model.
Soil water content at the condition of field capacity has been determined for both uniform and layered soil profiles by using the numerical model developed by Romano et al. (1998) and verified by Brunone et al. (2003). This model solves the Richards equation with the Crank-Nicolson finite difference technique and uses a numerical algorithm specifically designed in case of layered soils for calculating the hydraulic conductivity at the layer interface. For layered soil profiles, which actually represent the rule rather than an exception, soil layer sequence and the reciprocal differences in the soil hydraulic properties (soil water retention and hydraulic conductivity functions) strongly influence the attainment of the field capacity condition.
Simulations of soil water balance using the Richards-based model or the bucket-type model have been compared. It is shown that climatic seasonality typical of the Mediterranean environments exerts some influence on the dynamics of surficial water contents in soil and this influence can be kept only in part by the bucket model if not parameterized adequately. Rainfall variability during the vegetative season and that one evolving during the quiescent phase is responsible for different transpiration conditions and for evolutions of the water content in the soil characterized by specific trends. During the vegetative season, major controlling factors are the transpiration trend with respect to rainfall which assumes low values. During the quiescent season, on the other hand, the main controlling factor is rainfall trend.