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How to reach behavioural physically based models by reducing parameter uncertainty

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The parameterization of soil hydraulic properties of soils under agricultural land use is still very uncertain. In addition it is very difficult to consider (changing) soil surface conditions depending on different land use types in hydrological models. In this study soil hydraulic properties represented by the van Genuchten parameters were derived on the basis of three parameterization options with the computer programs Rosetta Lite and RETC. (1) soil texture, bulk density and water content at pF 2.5 and 4.2, (2) four points (pF 0, pF 1.8, 2.5 and 4.2) of the water retention curve, (3) three points of the water retention curve (exclusive of pF 0). In all three parameterization options the conductivity of the soil matrix (derived with Rosetta Lite) and the effective soil hydraulic conductivity (derived on core samples for the different soil horizons and with infiltration experiments for the soil surface) were considered. At a certain threshold of soil moisture (pF 2.5) the matrix conductivity increased linear to the effective (matrix and macropore) conductivity (macropore model). Parameterization option (1) was also tested with matrix conductivity and effective conductivity exclusively. The simulations were carried out with the physically based model CATFLOW (30m^2, 2D hillslope, Richard's equation). The simulation results were compared with runoff data from sprinkling experiments on plot scale. One of the grassland test plots produced only surface runoff because of a dense felt of dead grass and roots. If only the matrix conductivity is considered the runoff is highly overestimated. Considerably better results are attained by using the effective conductivity data or the macropore model. The parameterization of the deep soil hydraulic properties is less important for this

runoff type because it is dominated by the surface conditions. Totally different results show the plots on arable land. Here, the sprinkling experiments produced only interflow. Parameterization option (1) in combination with the matrix conductivity simulates surface runoff. The best results were attained with parameterization option (1) in combination with the effective conductivity. The usage of the macropore model or paramterization option (2) simulates the correct runoff type but didn't lead to better simulation efficiencies. Parameterization option (3) in combination with the macropore model simulates the dynamics of the "on/off" mechanism of macropore flow very accurate, but due to the absence of large pores in this option additional surface runoff is simulated. The determination of the effective hydraulic conductivity is crucial for a successful adoption of physically based hydrological models on the field scale. The derivation of the van Genuchten parameters on the basis of soil texture and bulk density is sufficient, if macropores or the effective saturated conductivity are taken into account. This leads to the conclusion that "classical" parameterization schemes of soil water models need to be revised: Data on grain size distribution and lab scale hydraulic conductivity has always to be extended by field based determination of effective soil hydraulic conductivities at soil surface. Otherwise neither the runoff generation process nor the correct amount of runoff can be determined properly by models based on Richard's equation.