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Propagation of the PTF prediction uncertainty into the simulated soil water budget at the hillslope scale

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Pedotransfer functions (PTFs) are being increasingly applied as a valid approach to estimate soil hydraulic properties at large spatial scales. However, the evaluation of PTF prediction uncertainty is still lacking, especially when PTF predictions are used to parameterise hydrological models of the vadose zone. In this study, a Montecarlo simulation is employed to investigate how the uncertainty in the soil hydraulic properties estimated by pedotransfer functions propagates into the simulated soil water fluxes at the hillslope scale in a dry season. The experimental hillslope is located in the Agri River Basin (Basilicata, Italy). Soil physico-chemical and hydraulic properties have been measured along a hillslope transect in 45 locations, with 50 m spacing. The spatial structure of the physico-chemical soil properties across the hillslope is identified by analyzing the correlation with terrain attributes, the semivariograms and their reciprocal cross-variograms. A sequential Gaussian simulation algorithm is used to generate multiple equally probable images of residuals of physico-chemical soil properties, consistent with the estimated spatial structure and conditioned to the measured soil core properties. A high resolution soil map (named the full set) is then generated, covering an area of 2200 m long and 1000 m width, including the point observations along the transect. The full set is sampled according to three grid resolutions: 50 m, 100 m and 200 m. Therefore, three sets of 100 stochastic images of the original full set, conditioned respectively to three sample grids, are generated by sequential simulation. Multiple patterns of soil hydraulic characteristics are then estimated with PTFs by HYPRES and Vereecken, applied to the observed and the generated soil physico-chemical properties. The vertical soil heterogeneity is neglected. Microclimatological and soil hydrological data observed in a nearby slope for three dry months, right after a

rainy season, are used to define soil initial and boundary conditions, assumed uniform across the hillslope. Vegetation is parameterised as short grain, spatially uniform and temporally stationary. The hillslope is modelled as a battery of independent vertical columns, without reciprocal interactions. The SWAP model, a Richards based soil-vegetation-atmosphere model (van Dam et al., 1992), is applied to each column. The uncertainty in the simulated evaporation, transpiration and water flux at the bottom of the root-zone, is then evaluated according to the different soil sampling strategies at the hillslope scale. The numerical results show that transpiration fluxes are estimated with a small bias and limited uncertainty at the hillslope scale with both PTFs, even for the coarsest soil sampling resolution. The application of Vereecken PTF also provides predictions of the bottom fluxes with a good accuracy. With both PTFs, but particularly with HYPRES, the bias of the estimated evaporation fluxes is instead very high compared to the uncertainty associated to the sample spacing.