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Uncertainty analysis for PTF at the hillslope scale

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Modeling soil hydrologic processes across different landscape elements is of prime importance for many studies applied to environmental and land-use planning problems. Nevertheless, the application of soil hydrological models at large spatial scales is often limited, chiefly because it requires the determination of soil hydraulic parameters that are difficult to assess by direct observations, especially over relatively large land areas. Pedotransfer functions (PTFs) are being developed as simplified methods to translate readily available soil data into parameters required by soil hydrological models. In this study we designed a general methodology for assessing the uncertainty in estimated soil hydraulic properties and simulated soil water budget resulting from the application of PTF at hillslope scale. The proposed procedure takes effects exerted by the spatial density of the available PTF input soil data also into account. Two sources of uncertainty are examined: (i) the error in estimated PTF input soil data and (ii) PTF model error. This methodology has been applied to an experimental hillslope in Southern Italy, where an intensive field campaign has been conducted to gather several PTF input soil data and soil hydraulic properties. A sequential Gaussian simulation algorithm is used to generate multiple equally probable images of PTF input soil data, consistent with the estimated spatial structure and conditioned to the measured soil core properties. Commonly used PTFs are then applied to evaluate the uncertainty in the predicted soil hydraulic properties. The predicted soil hydraulic properties are also employed into a soil-vegetation-atmosphere model to evaluate the uncertainty in the simulated evaporation, transpiration and soil water budget variation during a wet to dry transition season. With specific reference to practical directions when planning field campaigns, outcomes of this study suggest that the application of PTFs provide accurate and precise estimates of the soil water retention characteristic, transpiration flux and soil water storage variation at the hillslope scale even for a relatively coarse

sampling resolution of basic soil hydraulic properties. The examined PTFs show worse level of performance when they are applied to predict the hydraulic conductivity and evaporation fluxes. In this case the PTF model error is much more significant than the input uncertainty, even at very high sample resolution. A major implication of the outcome obtained is that if one would reduce the prediction uncertainty of these quantities, the PTF model structure has to be improved prior of reducing the uncertainty in the PTF input soil data.