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Sensitivity and uncertainty analysis of estimated soil hydraulic parameters for simulating soil water content

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The sensitivity and uncertainty analysis has been carried out for the scalar parameters (soil hydraulic parameters (SHPs)), which govern the simulation of soil water content in the unsaturated soil zone. The study involves field experiments, which were conducted in real field conditions for wheat crop in Roorkee, India under irrigated conditions. Soil samples were taken for the soil profile of 60 cm depth at an interval of 15 cm in the experimental field to determine soil water retention curves (SWRCs). These experimentally determined SWRCs were used to estimate the SHPs by least square optimization under constrained conditions. Sensitivity of the SHPs estimated by various pedotransfer functions (PTFs), that relate various easily measurable soil properties like soil texture, bulk density and organic carbon content, is compared with lab derived parameters to simulate respective soil water retention curves. Sensitivity analysis was carried out using the monte carlo simulations and the one factor at a time approach. The different sets of SHPs, along with experimentally determined saturated permeability, are then used as input parameters in physically based, root water uptake model to ascertain the uncertainties in simulating soil water content. The generalised likelihood uncertainty estimation procedure (GLUE) was subsequently used to estimate the uncertainty bounds (UB) on the model predictions. It was found that the experimentally obtained SHPs were able to simulate the soil water contents with efficiencies of 70-80% at all the depths for the three irrigation treatments. The SHPs obtained from the PTFs, performed with varying uncertainties in simulating the soil water contents.

Keywords: Sensitivity analysis, Uncertainty estimation, Pedotransfer functions, Soil hydraulic parameters, Hydrological modelling