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Uncertainty assessment in water transport models in semiarid Inner Mongolia steppe

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A challenge of soil water transport modeling is the assessment of various uncertainties resulting from parameterization of soil hydraulic characteristics, from boundary condition applied and estimation of source/sink terms like plant water uptake. The objective of this paper is, adopting three contrasting and widely used parameterization methods for the defined error source (including the parameters and input data), to assess the model uncertainty in predicting plot-scaled soil moisture. HYDRUS, a physically-based hydrologic model was used to incorporate these uncertainties, and the model outputs were compared with measured water content collected in semiarid Inner Mongolia steppe, China. Soil hydraulic characteristics (expressed by van Genuchten model) were parameterized by two direct methods (water retention data and evaporation method), and an indirect method (pedotransfer function), respectively. While each hydraulic parameter approach generally simulated well the trend of soil moisture, the evaporation method showed the perfect agreements. This suggested that the measurement in unsaturated hydraulic conductivity be necessary or even critical to ensure reasonable simulation of soil-water patterns, especially in a semiarid area where soil is mostly under an extreme dry (unsaturated) situation. Based on this best validated hydraulic parameters, we further showed the dependence of simulated soil moisture on the inputted boundary data, i.e. reference FAO evapotranspiration (ET) was partitioned by i) soil fraction cover, ii) leaf area index, and iii) crop height. The results showed the partitioning via soil fraction cover reflected the better simulation. Moreover, the uncertainty of a root constant model with root water uptake parameters referenced to i) grass and ii) pasture, and iii) a root growth model (only referenced to grass) in prediction were also compared, and no significant difference was found. Compared with three sources of uncertainty in predicting soil moisture, we conclude that the input parameter (e.g. soil hydraulic characteristics) is more sensitive than input data (e.g. ET partitioning or root quantification).

Keywords: Uncertainty analysis, Soil water simulation, Unsaturated conductivity, Evapotranspiration, Root water uptake