Identification of optimal soil hydraulic functions and parameters for predicting soil moisture

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Abstract The accuracy of six combined methods formed by three commonly-used soil hydraulic functions and two methods to determine soil hydraulic parameters based on a soil hydraulic parameter look-up table and soil pedotransfer functions was examined for simulating soil moisture. A novel data analysis and modelling approach was used that eliminated the effects of evapotranspiration so that specific sources of error among the six combined methods could be identified and quantified. By comparing simulated and observed soil moisture at six sites of the USDA Soil Climate Analysis Network, we identified the optimal soil hydraulic functions and parameters for predicting soil moisture. Through sensitivity tests, we also showed that adjusting only the soil saturated hydraulic conductivity, \( K_s \), is insufficient for representing important effects of macropores on soil hydraulic conductivity. Our analysis illustrates that, in general, soil hydraulic conductivity is less sensitive to \( K_s \) than to the soil pore-size distribution parameter.

Key words soil moisture; Richards equation; soil hydraulic functions; soil parameters; macropore; soil pore size distribution index

1 INTRODUCTION

1.1 Background information

Soil moisture is an important variable influencing the partitioning of solar radiation into sensible and latent heat fluxes and the separation of precipitation into infiltration and surface runoff, and thus plays a vital role in affecting the atmospheric boundary layer, weather and climate (e.g. Deardorff 1978, Dickinson et al. 1986, 1993, Cuenca et al. 1996).