Spatial variability of soil hydraulic properties in a forested hillslope

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Abstract

Spatial variability of soil hydraulic properties was measured in a forested hillslope and analyzed by applying combined water-retention-hydraulic-conductivity models (the LN and VG models) and a power function model for soil hydraulic conductivity (the Leibenzon model). Results showed that the pore-tortuosity parameter*l* in the LN and VG models should be treated as a fitted parameter for accurate descriptions of the unsaturated conductivity. The simultaneous optimization of both retention and conductivity curves is preferable to obtain appropriate descriptions of hydraulic properties when both retention and conductivity data are available for the parameter estimation. The Leibenzon model produced slightly poorer estimates than the LN and VG models. The exponent parameter in the Leibenzon model exhibited a spatial variation with the standard deviation of 2.38. The spatial variability of hydraulic properties was analyzed based on the spatial variation in parameters of the LN model obtained by the simultaneous optimization procedure. The parameter ψ_m, which has a positive correlation with median pore-radius, was generally small at the crest and upper slope locations and large at mid-slope to footslope locations. Except for the crest, surface soils had larger ψ_m values than the subsurface soils, suggesting a well-developed crumb structure in surface horizons of forest soils. For most soils, σ was greater than I, indicating a relatively large width of pore-size distribution. Saturated hydraulic conductivity (K_s) was generally small at crest and upper slope locations, and large at mid-slope to footslope locations. The largerK_s values were attributable to largerψ_m values.

Key words forest soil - hydraulic conductivity - parameter estimation - soil water retention - spatial variability