



An analytical solution to the one-dimensional linearised Richards' equation in a non-homogeneous soil

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In order to investigate the influence of the effect of the soil vertical non-homogeneity on the runoff production, an analytical solution of the linearised Richards' equation was derived. Here the vertical profile of the saturated hydraulic conductivity K_s is considered exponentially decreasing downward as indicated by field data reported in the literature and collected during our surveys in mountain catchments. Gardner's constitutive laws were chosen for $K(s)$ and $\Psi(s)$. The obtained formulation of the one-dimensional Richards' equation is linear and its coefficients are variable with exponential decay along the vertical axis. A solution was then found by using the method of the Laplace transform and compared with some test cases. The solution accounts for quite a different behaviour in the moisture dynamic, whether the soil response is mostly governed by diffusion effects, due to the soil suction, or by the transport effects, resulting from the assumed reduction of the saturated conductivity with depth.