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# Steady infiltration in gradually layered soils: a thoretical case study

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In order to better understand the effects of the soil hydraulic conductivity at saturation $K_s$ on the water content dynamics in a layered soil, a steady infiltration process was modeled in a soil characterised by exponential decreasing of $K_s$ with depth. The soil domain is assumed finite, unsaturated, and the flux takes place toward the increasing water content direction. At the bottom of the domain a saturation condition is assumed. By means of analytical solutions of the Darcy's law, the profiles of the total ($\Phi$) and matric ($\psi$) water potential, of the conductivity ($K$) and of the effective degree of saturation ($s$) were determined and compared with a numerical solution. Two soil classes of constitutive laws were considered, respectively characterised by ($i$) a finite and ($ii$) an infinite slope of $K(\psi)$ as it approaches the soil saturation.

The obtained profiles stress the high sensitivity of the solution to the $K(\psi)$ model near saturation, and its effects are furhermore emphasized by the decrease of $K_s$ with depth. For the second soil class, in fact, a strong reduction of the saturation value $K_s$ is represented for $K$, even for very little values of $|\psi|$ which means nearby saturation conditions. With regard to the first soil class, the flux needs a higher value of the gradient $|\mathrm{d}\Phi/\mathrm{d}x|$ to take place, and values of $\psi$ are much closer to the saturation values throughout the soil profile. The flux is therefore sensibly governed by gravity.

The obtained results can contribute to improve our understanding of the role played by the upper layers of dishomogeneous soils to control the infiltration processes.