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# Analytical solutions of the linearized Richards equation with flux boundary conditions for a half space and a finite layer

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A useful insight of physical mechanisms related to the complex hydrological problems can be provided by analytical solutions of differential flow equations (e.g. Richards equation). Although analytical solutions may be not suitable to solve complex hydrological problems, they are fast and useful to test numerical procedures. The aim of this work is the study of the water flow in a sub-surface unsaturated layer (Vadose zone). In this context, the linearized Richards equation is analytically solved for arbitrary flux boundary conditions and arbitrary soil moisture initial conditions. Approximating the supplementary conditions by step-wise functions, the solution results a sum of solutions obtained for constant boundary conditions. This approach is quite useful because it permits to use standard meteorological data as boundary conditions. In fact, it can be used precipitation data as incoming flux and evaporation from Bowen ratio data as outgoing flux; these data are very common, while soil volumetric water content measurements are usually not available exactly at the soil-atmosphere interface. The study is extended to a finite layer schematisation, which can represent a real situation, in case of a shallow water table. The aforementioned solutions hold till the saturation is reached; after saturation behaviour is under study.