

Recent Advances in Hydrological Sciences

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Abstract. Accurate analytical solutions of Richards's equation are presently based either on an iterative method or an expansion procedure. Both methods rely on replacing Richards' PDE by an integral equation. A general exact solution, from the first term in the expansion, is obtained for any soil properties as traveling wave solution. Remarkably this solution describes the water profile when flow instability leads to column flow. Richards's equation can also be used to predict the column width. However, Richards's equation cannot be employed to describe the water content of the wetting front as the instability develops, as wetting takes place over very few pores and a continuum description of the flow does not hold. A reliable solution to this problem does not exist at present.

Another practical and important problem concerns the transport of sediments in surface flow. At present most models of erosion use some modified form of the USLE. A more fundamental approach based on a stochastic description is described, giving a more physical interpretation of the processes involved in erosion and in sediment transport