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Three-dimensional modelling water flow and solute transport through a ditch in a farmed Mediterranean catchment: multicriteria parameter identification .

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Channels and ditches are known in arid and semi-arid areas to be zones of preferential infiltration of water and solutes and, thereby, to contribute to groundwater recharge. For many environmental purposes, including water resources assessment and risk analysis of water contamination, it is therefore essential to be able to model the surface-subsurface flow processes that occur within and at the vicinity of channels and ditches. This study presents a three-dimensional simulation approach of the infiltration process in a ditch of a Mediterranean catchment and of the resulting recharge process of a shallow watertable. The specific aims of the modelling approach were i) to evaluate the performance of a Richard's based simulation approach, ii) to identify by inverse modelling the best set of soil-ditch hydraulic properties, iii) to test the relevance of a multi-criteria calibration for the inverse modelling approach.

The case study consisted in two infiltration experiments on a ditch in a catchment located in south-France near the town of Montpellier. One experiment was used for inverse modelling and the other for validation. The simulations were performed with the SWMS_3D simulation code (Simunek et al., 1995), which computes three-dimensional saturated-unsaturated water flow and solute transport. For calibration and validation, three criteria were considered : Infiltration rates, watertable levels at different distances from the ditch, soil water potential profiles. Four scenarios of hydraulic parameter distribution were tested : a priori scenario with observed values obtained by classical measurement techniques and three calibration scenarios : homogeneous isotropic soil profile, four isotropic layers profile, four anisotropic layers profile. The

main results were threefold. Firstly, a Richard's based simulation approach proved to be adequate for simulating water surface-subsurface flow in a ditch. Secondly, calibration and validation ranked differently the performance of the various scenarios. During calibration, the scenario with the largest number of fitting parameters, namely the four anisotropic layer profile, fitted the best. During validation, the simplest scenario, namely the single homogeneous layer profile, proved to be the best. This illustrates the principle of parsimony that should govern inverse modelling approaches. Lastly, using three calibration criteria enabled to discriminate between the scenarios; for example, the a priori scenario performed well for simulating soil water potential profiles but failed to simulate water table level evolution.