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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Shallow water table effects on water, sediment and pesticide transport in vegetative filter strips: Part A. non-uniform infiltration and soil water redistribution" *by* Rafael Muñoz-Carpena et al.

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In this paper, an integral form infiltration model is presented and tested for modelling unsteady state infiltration in Vegetative Filter Strip (VFS) systems, subjected to variable top boundary conditions, and a lower boundary condition determined by the presence of a shallow water table. The new integral infiltration model is a further development of approaches presented by Salvucci and Entekhabi (1995) and Chu (1997). The model is numerically implemented and compared to solutions obtained from a fully mechanistic model based on the solution of the Richards equation (i.e. the reference solution).

The development of the infiltration model is relevant for evaluating the functioning and potential of VFS systems, which are considered as effective management systems to reduce the impact of agricultural practices on runoff, sediment load and surface water contamination. Little is known on the impact of shallow water tables on VFS functioning. Hence, this study fills an important existing knowledge gap, and the developed model, in combination with a VFS model (see companion paper) has a strong potential to be used for designing improved soil and water management in agricultural ecosystem.

The paper enters in the scope of HESS, is well written and well structured, it follows a logical approach and is therefore a significant contribution to hydrological science. Yet, the manuscript suffers from some weaknesses that should be considered in a revision of the manuscript before it can be accepted for publication.

Concerns can be summarized as follows:

1) Unclear development of some of the infiltration concepts and underlying equations. Some of the parameters/variables or conceptual explanations in Eqs. (4), (9), (10), (12), (13), (17) and (19) needs reconsiderations. For instance, for Eq. (4) and (9), the authors should clearly explain the significance of f, and why they consider it as z-dependent. In Eq. (10) authors should develop in detail the underlying hypothesis of the linearity of the unsaturated hydraulic conductivity curve, and explain the derivative to z_p in stead of z. Also there is mix up of the signs in Eq. (12) and (19). Finally, it is unclear how the suction head at the infiltration front is evaluated, which in principle should be evaluated using the unsaturated hydraulic properties of the unsaturated soil (and hence between the wetting front and the water table). Detailed concerns have been marked up in the annotated manuscript.

2) Authors should also demonstrate the efficiency of the integral formulation of the infiltration problem by comparing it with the reference solution (Richards equation based) on a CPU calculation time basis. Given the fast development of processing capacity in modern computing system, but also progress in solving the non-linear Richards equa-

tion (e.g. de Maet et al., 2014), the reference solution of the Richards equation should become strongly competitive with the presented integral infiltration form model on a CPU time basis. Hence, the problems associated with the reference should no longer be a strong issue.

3) Finally, there is a set of small editorials that are marked up in the annotated manuscript.

References: De Maet, Thomas ; Hanert, Emmanuel ; Vanclooster, Marnik. A fully-explicit discontinuous Galerkin hydrodynamic model for variably-saturated porous media. In: Journal of Hydrodynamics, Vol. 26, no.4, p. 594-607 (June 2014). doi:10.1016/S1001-6058(14)60067-6.

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2017-405/hess-2017-405-RC1-supplement.pdf

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