***Authors Response to Interactive comments 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.**

RC1- M Vanclooster (Referee)

Thank you very much for the careful review and edits to the initial submission. Below we address the comments raised on the initial submission and we have also revised the manuscript accordingly to accommodate these. Please note that we uploaded the revised manuscript as a supplement to these response comments.

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.

> AR-1: Yes, thank you for catching the errors made in the transcription of the equations into the manuscript. Specific details for the revised equations follow:
>
> Eq. 4. Based on Neuman (1997, Eq. 7) the infiltration rate in the soil under Green-Ampt conditions can be approximated the unit gradient saturated flow reduced by an integral term representing flow in the unsaturated domain (ψ is the soil pressure potential ≤ 0) below the wetting front,
>
> $$f = f_p = K_s - \frac{1}{z_F}\int_0^{\psi_i} K(\psi)\mathrm{d}\psi$$
>
> were ψ_i is a sufficiently low unsaturated pressure head (high negative value) at which the unsaturated conductivity *K* is negligibly small. Assuming negligible soil surface pressure (H_p=0 at z=0), non-uniform soil moisture controlled by equilibrium with the shallow water table, and expressing in terms of soil suction (h= - ψ) Chu (1997, eq. 4, 12) proposed that the integral could be bounded over the soil depth between the water table and the wetting front where limits of integration become h[0, $L-z_F$],
>
> $$f = f_p = K_s + \frac{1}{z_F}\int_0^{L-z_F} K(h)\mathrm{dh}$$
>
> As suggested, we changed the equation to include z_F in the denominator and no just *z* (but not L-z_F).
>
> Eq. 9. Yes, changed to z_p and no just *z.*
>
> Eq. 10. Removed erroneous K_s from denominator. No, there is no need for limiting linear assumptions as the equation is general and applies to any hydraulic characteristics.
>
> Eq. 12-14. Yes, *f* should be f_p and it is now corrected.
>
> Eq. 16. Yes, changed to z_F.
>
> Eq. 17. This equation was correct based on the Newton-Raphson root-finding method used.
>
> Eq. 19. Redundant with previous equations and removed. Also removed eq. 20 (with reference to Eq. 3).

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 equation (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.

AR-2: The three arguments in favor of the proposed algorithm for this specific application were: a) speed, b) robustness, and c) physical consistency with the model (VFSMOD) used in the follow up paper that uses (Chu 1978 and Skaggs and Khaleel , 1982) extension of Green-Ampt for unsteady rainfall conditions without the presence of a shallow water table. VFSMOD is used in current long-term pesticide regulatory assessments (30 yr. daily time steps in the USA or 10 yr. daily time steps). Considering ~1/3 to ~2/3 of days with rainfall-runoff, the model would be run between 3000 and 7000 times for a 30 yr. assessment. Even a marginal time improvement can prove advantageous in this type of throughput applications. As suggested by the reviewer, we performed a quick comparison between the CHEMFLO and SWINGO for D=10 h for the cases in Fig. 5, with small speed differences of 1-5 s between both solutions (CPU: 1.6 GHz Intel Core 2 Duo). However, the differences will likely be compounded in the context of the throughput simulations presented above. The results are machine and computer and compiler dependent, and as such an unfair comparison between both types of solutions. CHEMFLO contains a graphical interface, a standard finite differences solution implemented in Java computer language (run in Oracle ® jre-8u144), and is not intended for optimized simulations. SWINGO was implemented in Fortran (Intel ® Fortran Compiler v17.0.4). Admittedly, the differences will likely be smaller with optimized code and new developments of Richards implementations suggested by the reviewer e.g. de Maet et al., 2014). A new discussion at the end of section "3.1 Numerical testing" is now added to the revised manuscript with these considerations and reference.

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

AR-3: We revised the manuscript and addressed all minor comments following the reviewer's suggestions.