Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-75-AC1, 2016

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Variable Saturation Infiltration Model for Highly Vegetated Regions" *by* James Polsinelli and M. Levent Kavvas

James Polsinelli and M. Levent Kavvas

jfpolsinelli@ucdavis.edu

Received and published: 16 June 2016

Response to Referee #1:

Generally, I will make necessary clarifications and re-organize the article in order to give the best presentation of the ideas in this article.

Response to comments on the abstract: I will rewrite the abstract to introduce the Variably Saturated Rectangular Profile model, comment briefly and clearly on what situations it may be useful, and the model's computational efficiencies. The focus of the article should be clear to every reader after the abstract, and I will fix this section to ensure that.

Response to comments on the introduction: I agree that the limitations of Richards

equations and the Green and Ampt model are well documented; therefore these discussions may be shortened or removed. One of the primary advantages of this model is it's ability to model flows in horizontally heterogeneous soils. I agree that a discussion of hydraulic conductivity distribution on soil moisture dynamics will be interesting. A systematic review of representations of hydraulic conductivity could be useful given the utility of this particular model.

Response to comments on section 3.1: I will re-organize this section to explain the methodology of the sub-saturated model and can investigate comparisons with Richards equation for soil hydraulic conductivities corresponding to finer grained soils.

Response to comments on section 3.2: I will make it clear that I am not addressing the redistribution phase of soil water.

Response to comments on section 3.3: I will clarify that horizontal heterogeneity alone is considered and state explicitly the assumptions on the model.

Response to comments on section 4: There have been both field studies and theoretical studies on the merits of Brownian and fractional Brownian fields as models for heterogeneous soils. I will provide proper references for these studies.

Response to comments on section 5: The initial condition for the numerical simulations will be determined by the initial saturated hydraulic conductivity (which is constant in time in these trials), and the initial rainfall rate (also constant in these trials). If the former is larger than the latter the initial condition of the moisture can be determined, if the latter is larger than the former then the initial moisture content cannot be determined under the assumptions of the Green & Ampt model. The moisture content will be the saturated content after the time to ponding has been reached. This will be clarified and expanded upon in my revisions. The grid size is small for a typical hydrologic study, it was picked as a matter of convenience in generating the Ks fields. However, since Brownian and fractional Brownian fields are self-similar, the grid and the Ks fields can be scaled to a more hydrologically relevant size.

Response to comments on the conclusion: The goal of the numerical demonstrations was to show the dynamics of the model under degrees of variability in the soil type (the soil Ks). The Ks fields were picked to have fields with differing soils (or differing vegetation) where the magnitude of the Ks changed by an order of magnitude or more. See Figure 6, there are instances of three fields with different Hurst coefficients, with values of Ks at different cells varying between less than 0.1 and 2 (H = 0.3), less than 0.01 and 0.07 (H = 0.5), and less than 0.01 and more than 0.07 (H = 0.7). The noisiness of the three fields varied greatly, with H = 0.3 anti-persistent, H = 0.7 persistent, and H = 0.5 classical Brownian motion. The ease of modeling such irregular fields was the focus of the experiments. More complicated rainfall conditions could be attempted, but a storm event with multiple rainfall events would involve significant complication due to the redistribution (not a focus of the study) and would not truly add dimension. A single variable rainfall event will be included in the revision. Numerical simulations with at least two different soil texture classes will be included and the different soil textures clearly identified.

I will correct all the technical errors and inconsistent terminology that were pointed out.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-75, 2016.