Hydrol. Earth Syst. Sci. Discuss., 6, C2347–C2350, 2009
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Hydrology and Earth System Sciences Discussions

Interactive comment on "Iterative approach to modeling subsurface stormflow based on nonlinear, hillslope-scale physics" *by* J. H. Spaaks et al.

Anonymous Referee #3

Received and published: 13 October 2009

This is an interesting modeling exercise to assess the effects of transient subsurface saturation on hillslope discharge during storms. While the details of the simulations may not be totally realistic (as typical of many virtual experiments), the modeling exercise sheds important insights into the behavior of subsurface storm runoff under spatially and temporally varying conditions of saturation. For this reason, I feel that this rather simple set of simulations represents a valuable and publishable piece of work. I like the fact that the authors addressed the leakage of excess water into bedrock in this model (this has typically been ignored and I think it is important), but I wish they would have explained and justified this calculation a bit (including the illusive K_l parameter)

and showed how significant this was in their simulations.

The paper is reasonably well written, although in my comments that follow I make a few suggestions to improve the technical presentation. The organization of the paper is a bit different, as a separate section is devoted to each virtual experiment. Assuming that the authors can successfully address the technical and editorial issues that I raise, this paper should make a nice contribution to *Hydrology and Earth System Sciences*.

More substantial technical comments that need to be addressed by the authors:

1. **Selection of the single storm you used in simulations**: Firstly, this storm does not seem like such a major event. Thus, given the long history of storm data collected at Panola, I am wondering why this was selected, and why only one storm was tested. Using several storms with different characteristics would have made an interesting comparison. Anyway, please justify your use of this single event.

2. **Section 6 of this paper**: I found this section of the paper not so well developed and described compared to the other virtual experiments. In this experiment you imposed a very different type of storm (small and rather low intensity) to 'better assess differences in flow timing and magnitude between models 1 and 3. You need to more clearly state why this virtual experiment can accomplish this goal; specifically, why a small storm is better to use. Also, maybe less details and a better overview would benefit this section as a whole. Could you include a schematic to help illustrate what you are doing here? The tabular information you present contains the details but not the 'big picture'. Overall, this section needs some work to justify its existence.

3. **Section 3.2.4**: As I noted, I like the fact that you included leakage, but this process really should be described and justified in more detail; e.g., I have no idea what the K_l parameter is or how it would be measured/estimated. And I would

have really liked you to have shown how this part of the model behaved during the storm (as well as other hydrological components).

4. **Summary and Conclusions:** Overall I felt this section was a bit long and could have focused more concisely on the important comparative findings, instead of the blow-by-blow summary description. This needs some work.

5. **General Comment:** While I am not really a big fan of virtual models, the approach taken here provided some useful insights into important hillslope hydrological processes. What would have made this a much better paper, would have been the assessment of the behavior of individual hydrological components that were part and parcel to these models.

Other minor technical and editorial issues that need to be addressed by the authors:

- Pg. 5206, l. 17-18: your expression 'discharge being too steep' and 'not steep enough' seems a bit strange; the discharge is not steep, it is the rate of change of discharge that is steep.
- Pg. 5207, l. 8: I would substitute "a relatively low permeability layer' for 'impermeable' because of what I discussed earlier about 'leaky bedrock'.
- Pg. 5207, l. 13: Including the Weiler et al., 2005 reference here along as an example of an early classic reference for subsurface stormflow is not appropriate; if you need another reference, I suggest Whipkey's 1965 paper.
- Pg. 5208, l. 7: Actually a better reference than Sidle et al., 2000 is Sidle et al., 2001 (also in HP, reference given later)
- Pg. 5208, l. 9: instead of 'channels' in the bedrock, I would say 'fractures and joints'

- Pg. 5208, l.12: in addition to Phillips, 2003, here is where the Sidle et al., 2000 reference would fit (as well as on pg. 5211, l. 8).
- Pg. 5209, l. 8: Could you please elucidate the 'downward approach'?
- Technical writing issue (example; pg. 5214, l. 16-17; pg. 5215, l. 3; pg. 5218, l. 9, etc.) It is better not to start a sentence off with telling readers what is in a figure – we can see this. Simply make a statement about the results of the figure that you wish to elaborate on and then put the figure number in parenthesis at the end of the sentence.
- In Figures 2, 4 & 5: There is a little confusing because you use A, B, & C to denote both different parts of the figure AND ALSO different portions of the x-axis. I recommend changed the notation on the x-axis (and in the text) to numbers.
- Pg. 5215, l. 6-7: Actually there is one rather steep section of simulated discharge rate change in sector B.
- Pg. 5215, l. 27-28: Why does this percentile contain only a few measurements? I may have missed something, but this is unclear and a bit confusing.
- Pg. 5223, l. 13: change 'between' to 'among'; also same comment on pg. 5226. l. 8.

I believe that once these issues outlined in this review are addressed, this can be a suitable contribution to *Hydrology and Earth System Sciences*.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 5205, 2009.