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Hydrology and Earth System Sciences Discussions

Interactive comment on "Controls on runoff generation and scale-dependence in a distributed hydrologic model" *by* E. R. Vivoni et al.

Anonymous Referee #3

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General Comments

This paper presents the results and interpretation of a set of modelling experiments aimed at gaining additional insight to the mechanisms that cause non-linearities in runoff generation in catchments. The paper is well written and clearly explained. The authors apply a complex spatially-distributed model that is based on a 'traditional' conceptualisation of runoff generation processes. The model has been previously applied using a multi-step calibration procedure and this is important in ensuring its robustness for this type of analysis.

I am a great believer in the value of model experiments for interpretation of catchment behaviour and therefore recognise the understanding that can be gleaned from this

type of approach. However, I suspect that some readers might question whether the analysis of the model behaviour actually tells us any more than the model equations themselves i.e. the non-linearities that are described and explained are inherent in the model structure. I think this aspect can be addressed be minimising some of the discussion of more intuitive behaviour, putting greater emphasis on the more novel outcomes, and presenting a more general discussion at the end of the paper regarding the implications of the results for other studies.

With the following comments taken on board I believe this paper will be an interesting and valuable addition to the existing literature on runoff generation processes.

Specific Comments

1. Results are presented for three different catchment scales in Figures 2 and 6. The results are difficult to compare across the scales because they are presented in terms of the total discharge. If the data were converted to specific discharge (discharge / area) they would be much clearer. The same goes for the discharge figures quoted on p993 l8. Also, the rainfall data for each of the 3 sub-catchments for each storm event cited in Table 1 would be useful, rather than just runoff ratios.

2. I am unconvinced about the generality of some of the scale effects that are discussed. For example, p998, l14-17, many upland areas have plateaux regions on the hill tops where groundwater drainage may be very slow. Conversely, agricultural activities in many lowlands has resulted in extensive sub-surface drainage networks, which tend to lower the water table. This would lead to the opposite effect from that presented, in terms of the basin water table.

3. Similarly, the discussion of the scale influence in section 4.4 appears to relate it, at least in part, to land use and the presence of more forestry in small catchments. This is unlikely to be particularly transferable to areas with different land use patterns. If this is the case, then perhaps it would be of more value to relate the processes to land use or soil type. Additionally, it is clear that in this example the land use and soils were

HESSD
4, S415–S418, 2007

classified together, and therefore it is difficult to disentangle the influences of the soil properties from those of the land use.

4. How much of the interpretation carried out is a function of the model structure used for the analysis? How might this have changed if, for example, the model included runoff from perched water tables, or by a by-pass flow mechanism? The model limitations need to be discussed.

5. A more general discussion of the implications of the experimental findings, beyond these particular catchments, would be useful. What are the more general messages and how will we use this understanding?

1. Does the paper address relevant scientific questions within the scope of HESS? YES

2. Does the paper present novel concepts, ideas, tools, or data? YES

3. Are substantial conclusions reached? YES

4. Are the scientific methods and assumptions valid and clearly outlined? YES

5. Are the results sufficient to support the interpretations and conclusions? YES - but with reservations about more general applicability regarding scaling

6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? YES

7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? YES

8. Does the title clearly reflect the contents of the paper? YES

9. Does the abstract provide a concise and complete summary? YES

10. Is the overall presentation well structured and clear? YES

11. Is the language fluent and precise? YES

HESSD

4, S415–S418, 2007

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? YES

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? NO

14. Are the number and quality of references appropriate? YES

15. Is the amount and quality of supplementary material appropriate? N/A

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 4, 983, 2007.