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Hydrology and Earth System Sciences Discussions

Interactive comment on "Rainfall threshold for hillslope outflow: an emergent property of flow pathway connectivity" *by* P. Lehmann et al.

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The reviewer mentioned that we are mixing conclusions from the model with real properties of the hillslope. In addition, the reviewer emphasizes that the reader can have the impression that the percolation model is the unique and complete explanation of the threshold phenomena. We rephrased the corresponding paragraphs more carefully and discuss this explicitly in section 5.2:

Section 5.2 Ability to replicate Panola behavior: While the percolation model can reproduce various aspects of the Panola hillslope, it is not intended to be a physically based hydrological model that provides a detailed description of small scale hillslope processes. We acknowledge that at this stage the parameters used here such as the coordination number may lack physical basis, however, we believe that the mod-

elling concept is ideally suited for systems in which connectivity is an essential system property. Processes that may affect the hillslope outflow not considered in this model include the distribution of rainfall water as a dynamic process resulting in lateral flow into sites without a free water table. In addition, the water flow along the bedrock is affected by large scale heterogeneities and the correlation length of the bedrock profile. As shown in Tromp-van Meerveld and McDonnell (2006a) the water flows preferentially out from a valley in the bedrock. Such large scale structures are not reproduced in the model because it is based on limited spatial information. Finally, the shown application of the model for conditions with dry initial conditions may be too simplified because it is based on the assumption of constant water content in the profile. Probably, the filling of the whole profile with water must be modeled in more detail to enhance the predictions.

Specific comments:

- Comment #1 (page 2924, lines 14-17): The sentence is reworded.

- Comment #2 (page 2925, line 11): The limitations of the bucket model are now shortly discussed in the introduction.

- Comment #3 (page 2926, line 8): The sentence about first order control is rephrased.

- Comment # 4 (page 2929 - 2931): The effect of the percolation threshold and the drainable fraction is now emphasized in section 2.2, 2.3 and the caption of Figure 3.

- Comment # 5 (page 2938, line 3): Other combinations with good results are shown in Table 2 as explained in section 4.2. Other possible combinations could be useful if the model was adapted to allow redistribution of free water to neighbored cells. This is discussed in the reply to the short comment of B. Schaefli.

- Comment # 6 (page 2942, lines 14 - 15): The sentence about the first order control is rephrased.

Minor comments:

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- Page 2925: the term ‘slope’ it is now explained as increase of runoff per increase of rainfall amount

- Page 2926: corrected according to the reviewer

- Page 2931: ’occupied and open with respect to water flow’ is now replaced by: ’In the percolation model, a site with a water table is denoted as occupied.’

- Page 2934: corrected

- Page 2951, Figure 1: For each site Y, X, the nearest neighbor (Y+y, X+x) in four directions (y $>$ 0, y $<$ 0, x $>$0, x$<$ 0) was determined. So, each neighbor (if it is not at the boundary) has at least four neighbors. If two sites have the same distance in a certain direction, both connections are drawn. A similar explanation is now added in the caption of Figure 1.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 3, 2923, 2006.