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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Impacts of rainfall features and antecedent soil moisture on occurrence of preferential flow: A study at hillslopes using high-frequency monitoring" *by* Z. Peng et al.

Anonymous Referee #3

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General comments:

Identifying the factors and mechanisms leading to preferential flow of water, solutes and suspended particles through the soil is a challenging research topic, and a matter of considerable significance as it can impact the quantity and quality of the rainfall or irrigation water reaching the groundwater. Many studies attempted to identify the impact of soil physical (e.g. macropore) and chemical (e.g. water repellency) heterogeneities on the onset of preferential flow. The paper under review aims at identifying – at the hillslope scale - the impact of boundary conditions linked to rain characteristics

(called 'rainfall features' in the paper) as well as one initial condition (antecedent soil moisture) on the onset of preferential flow. This is a topic of great interest for the scientific community interested in mass transfer in soils, and it falls well within the scope of HESS.

The paper major issue is that it is difficult to understand its novelty compared to already published studies. To which extent does it go farther than previous work on high frequency monitoring of preferential flow? One reason is that the introduction is poorly written. It does survey some literature results on hillslope scale monitoring of the occurrence of preferential flow, but fails to pinpoint the gaps and opened questions. This leads to a lack of precise scientific question to address in the paper. Was this work only a mere case study? This may be fine, but, if so, this should be clearly stated. A second reason is that, although the manuscript contains a discussion section, the experimental findings are not thoroughly discussed and compared to previous finding and scientific gaps. The current discussion section is a mere continuation of the result section.

In addition, the paper is difficult to read and understand because sentences are often awkward (e.g. page 9 lines 13-16), the wording imprecise, or the language register inappropriate for a scientific paper (e.g. 'bunch' is a rather informal noun). I advise the authors to seek the help of a native English speaker to address this issue.

Still, the amount of data collected in this case study is impressive and valuable for the community. It may be useful for future use to present in the supporting information section the hydraulic conductivity for each soil layer, as a function of depth, as well as the velocity of the wetting front for each rainfalls.

Specific comments:

1/The paper relies on two criteria to determine the occurrence or absence of preferential flow, based on (i) the non-sequential response of probes with depths and (ii) the velocity of the wetting front compared to some arbitrary threshold, 5 or 10 times the

hydraulic conductivity, depending on the depth. Although similar criteria have already been used in another paper (Hardie et al. 2013), they are not backed by any theoretical developments and their capacity to discriminate between preferential and equilibrium flow is not established. Non-sequential response of probes may arise from lateral infiltration of water, especially when the soil surface is not horizontal. In addition, (1) the wetting front velocity thresholds are quite arbitrary, and (2) since the threshold varied with depth, it is not clear from lines 7-15 page 5 when preferential flow was assumed to occur: was it when the wetting front velocity was higher than the thresholds at all the depths investigated? or at only one depth ? Other criteria have been proposed to establish the occurrence of preferential flow, for example, when the rainfall intensity exceeds the infiltrability of the matrix, the exceeding water flux is likely to participate to surface run-off , or, if macropores are present, to be involved into macropore flow (Nimmo, Vadose Zone Journal 2016, doi:10.2136/vzj2015.05.0079).

2/Page 7, line 6-12: were the spatial variations of the preferential flow frequency correlated with the spatial variations of the saturated hydraulic conductivity ? or with the ratio rainfall intensity/saturated hydraulic conductivity ? It may be interesting along with figure 6 to present, with a similar color code, (i) vertically, for each site: the average, minimum and maximum hydraulic conductivity, and (ii) horizontally, for each rainfall event the rainfall amount, duration maximum and average intensities.

3/What were the local topography of each site (e.g. swale, convex , slope. . .) ? Is there an influence of the local topography on the occurrence of preferential flow at each site as noted by Liu and Lin 2015 (SSSAJ 79, 362) ? Burrowing animal such as earthworms have been shown to affect the occurrence of preferential flow (e.g. Capowiez et al., 2014 Pedobiologia, 57, 303). Could their local density explain variations of preferential flow occurrence from one site to others ?

4/Figure 7: it may have been interesting to use the so-called 'violin-plots' to represent these data.

5/ When discussing the relationship between the average soil moisture and the frequency of preferential flow (figure 10), the authors indicate that the behavior of the graph is dominated by the contrasting soil moisture content of Slope I sites at the one end, and FH3 andFH4 sites at the other end. This unequal distribution of the sites on the abscissa of figure 10 is indeed important information when interpreting the figure. I wonder if the sites were equally distributed on the abscissas of the graphs shown in figure 8. An easy way to add this information to figures 8 and 10 would be to use stacked column charts.

6/ What were the values of the real and imaginary parts of the refractive index used to determine the particle size distribution by light scattering?

Specific comments:

Page 1: line 8: most of the time 'in order to' can be simplified to 'to'. Page 2, lines 18-27: This sections is unclear and difficult to understand, probably because (i) the sentences are too long and (ii) the ideas developed in this paragraph are not well organized (e.g in the same sentence (starting line 20 and ending line 24, both the influence on preferential flow of initially wet and initially dry soils are discussed, but it is difficult to understand exactly which arguments refer to which situation)

Page 4 line 16-17: "rainfall events were divides into ines. . .... rains". I was not able to understand this sentence.

Page 8, Line 1-2 I was not able to understand this sentence.

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