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.

Reply: Thanks a lot for your comments.

We will illustrate more to fill the gap between previous studies and our objectives. Basically, this study was initiated from two considerations. (1) It would be helpful in understanding the processes of subsurface hydrology, if we get the key factors that control the occurrence of preferential flow. Lots of studies have been carried out on this topic. However, contradictory results were obtained in different cases, e.g., the cases of Wu et al. (2014) and Hardie et al. (2013). And to our knowledge, no study on this topic has been carried out in northern China with sub-humid climate and poorly developed underlying soil. Hence, we think this study could be a complementary to the understanding of controlling factors of preferential flow; meanwhile, it would be helpful in understanding hydrological processes of the study area. (2) By far, there are many methods for the detection of preferential flow, but in-suit method is rather limited. The method using wetting front as an indicator, which was proposed by Lin and Zhou (2008) and later improved by Hardie et al. (2013), could be an alternative option. Since this method has been on applied in only two or three cases to our knowledge, it would be of interest to apply it in our study area, where climate and surface condition are different from previous cases. From this point of view, we agree that this study could be regard as a case study. And in the revised introduction, we will emphasis more about the difference between the study area and those of the previous studies, so as to illustrate the necessity to conduct studies at this area.

We've been hesitating whether to put Section 4 as discussion or as a part of results at the beginning. Thanks for your suggestion. We will combine Section 3 and Section 4 together as a section of "results and discussion". We will make more comparisons between our results with those of the previous studies, so as to make our results sounder and more meaningful.

Concerning on the language issue, we will have a native English speaker for some help during revision. We will check the syntax errors through the manuscript, and improve the presentations.

Thanks a lot for your suggestions on presenting a supporting information section. We will extend Table 2 to include detailed information of physical properties of soils at each depth. As well, we will find a proper way to present the wetting front velocities at each depth in each rainfall event, and as you suggested, a supporting information section would be a good choice.

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).

Reply: Regarding criteria (i), we agree that lateral infiltration may influence the responses of probes. However, it should be noticed that, (1) measurements of the probes were constant within one or two hours before rainfall, so it's reasonable to assume that the responses of the probes were caused by rainfall; (2) measurement of a probe covers an area of soils, but not a point. Therefore, if it were the lateral infiltration that caused non-sequential response, the water should have come from somewhere on the surface with a distance from the surface area right above the probe. In other words, water should have moved farther and faster in the lateral infiltration than in the vertical infiltration, no matter preferential flow occurred or not in the vertical infiltration. Therefore, it should be confident that the lateral infiltration flows through a preferred path.

Regarding criteria (ii), we think that the threshold is arbitrary to some extent, but not totally. Given the complexity of the v_{wf}/k_s ratio of equilibrium flow in various conditions, we are afraid it's beyond the reach of this study to have a theoretical based threshold. In Hardie's et al. (2013) study, the threshold was rather conservative. They made sure that equilibrium flow would not readily be misjudged as preferential flow, and they got reasonable results. However, this conservative threshold may have misjudged preferential flow as equilibrium flow more often, since the wetting front velocity would decrease with depth. In view of this problem, we adjusted the threshold to lower velocity.

We are sorry that we did not state clearly about the criteria of preferential flow occurrence of a site. To be short, by our criteria, preferential flow occurs at a site as long as it occurs at one or more depths of the site.

Thanks a lot for reminding us of other criterion. However, given our limited knowledge of soil morphology in the study area, we are not able to study in-detail about the flow paths; and because of the unknown interception and storage of water by the surface cover, it may not be feasible to compare between the rainfall intensity and infiltrability of matrix in such a short time scale.

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.

Reply: It's a wonderful suggestion, and thanks a lot. We will try on this issue in revision, and will present the result in the manuscript if it's significant.

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?

Reply: We think we have some discussion on the topography issue, though not very in-detail. We compared the responses of soil moisture to the same rainfall event between site FH3 and site S1H3 (see Figure 12). The former site is located in a relatively flat area, and data shows that maximum soil water storage increment at this site exceeded the rainfall amount, while the later is located on hillslope, and only small portion of rainfall water infiltrated into soils. This could be reason why soil moisture at FH3 was continuously higher than that at S1H3, and so were the frequency of preferential flow (see Figure 11).

The spatial variation of burrowing animal density could be an explanation that could not be excluded, but it's also involved with other similar factors, e.g. the root density. Detailed inspections of these issues are needed to make quantitative analysis, but it's beyond the reach of our data currently. We agree that this issue is worth-noting, and we will try to have some discussion about it in future studies.

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

Reply: Great suggestion! We will redraw the figure using the violin plots; it will present the density distribution of the values much more clearly. Thanks a lot.

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.

Reply: Thanks a lot. It will be easier to show the contribution of each site to the frequency of preferential flow.

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?

Reply: The particle analysis was done by another group of people several years ago, and they did not record the settings. But as we can remember, the values were set differently for each sample to fit the data. Values of the real part were generally between 1.5~2.0, and the values of the imaginary parts were 0.01i~0.1i.

Specific comments:

Page 1: line 8: most of the time 'in order to' can be simplified to 'to'.

Reply：We will simplify the presentation.

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)

Reply: We will re-organize the presentations with help of a native English speaker.

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

Reply: We will rewrite the sentence to make it clearer. Generally, this sentence means that in this study, duration of a rainfall event is not longer than 24hrs. But in sometimes, the rain continues for a long time and cannot be cut apart by the 24-hr bar, so duration of the rainfall event will last for a longer time, but not longer than 48hrs.

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

Reply: We will rewrite this sentence.