

## ***Interactive comment on “In situ investigation of rapid subsurface flow: Identification of relevant spatial structures beyond heterogeneity” by C. Jackisch et al.***

**Anonymous Referee #3**

Received and published: 15 June 2016

The manuscript presents experimental techniques and results that allow identifying relevant structures in soils at three spatial scales that could be responsible for the generation of preferential flow along hillslopes. The authors wanted to obtain a better understanding of the structure-related flow processes by utilizing all information from complementary techniques, to finally improve the conceptual modelling of hillslope hydrology. The topic, data, and analyses are of interest and fully in the scope of the journal; experimental results appear technically sound, of high quality and relevant. General Comments: I was impressed by the large amount of high quality experimental data that are presented. Almost each one of these experiments could have been the basis for an individual study and a detailed analysis (i.e., the time-lapse GPR results);

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but as I understood, the idea here was to bring information obtained by the various techniques and at the three spatial scales together such that it would fit into an integrated overall conceptual picture or description of the rapid flow in hillslopes. This highly ambitious goal could probably not fully be achieved in the present manuscript such that it still has the appearance of a more-or-less loose collection of experimental results. This could probably be improved by including an introductory conceptual scheme (perhaps as a figure) in which the hypotheses are summarized such that the reader can see why and where the various measurements were required to obtain certain information. Possibly, it may turn out that some information is not really necessary for the identification of the structures? The manuscript presentation should be improved. In the present form, the manuscript appeared to me more like a research report than a scientific paper and not very specific. Clear hypotheses and objectives are missing or hidden somewhere in the text. In contrast to the detailed experimental results, the analysis is descriptive and mostly rather general, such that the identification of the flow-structure relation seems to remain largely qualitative. For instance, flow pattern relations with structures of soil horizon and patchiness were identified, which is interesting, but how could this be quantified? Despite the large number of techniques, why was the use of tensiometers not considered, not even mentioned?

Detailed comments 1. The abstract is not informative and far too general. From the abstract is it unclear what was done; hypotheses, objectives, methods, results and conclusions are missing. 2. The soil water retention data are not used in the analysis (why did you show it?), why did you present drying retention data when analysing the infiltration; rapid flow events require knowledge of wetting curves or hysteretic behaviour? 3. Page 22 Line 15: did you really observe the macropore-matrix exchange? How and where do you use it? 4. Discussion: In the discussion, the referencing to figures or tables that show the results is mostly missing. 5. Page 23 Line 10: Can't you draw a sketch of these ideas? 6. Page 24 Line 1: How did you use the water Retention data? 7. Page 24, chapter 4.2.2. I did not understand why tensiometers were not considered at all. The driving force is the hydraulic potential in unsaturated soils; matric potential

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is also more sensitive than soil moisture especially with rapid processes. 8. Page 24, Line 16: I did not understand this statement: "...the quantification of advective water from the recorded changes in soil moisture has proven not feasible...", a new finding? 9. Conclusions: At the end I was wondering if your goal was a novel hydrological survey tool or an improved conceptual model.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-190, 2016.