

## ***Interactive comment on “In situ investigation of rapid subsurface flow: Temporal dynamics and catchment-scale implication” by L. Angermann et al.***

**Anonymous Referee #2**

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General comments: This paper presents an interesting experimental approach, combining different types of measurements and techniques (soil moisture monitoring, time-lapse GPR, discharge and tracer measurements) to investigate mechanisms of rapid subsurface flow. Such combinations are often very promising as they can yield new interpretation of observations and new insight. The visual presentation of results, i.e. the figures, is very well done, the figures are informative and mostly well structured. The language is mostly suitable, with sentences sometimes being quite long. Here a language revision would certainly help to make the text more pleasant to read. However, I do not think that the authors achieve their objective of investigating and providing new insights into rapid subsurface flow processes. As they themselves state in the Con-

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clusions, the link between processes and structures is still missing, many statements remain speculations and thus, an exciting new insight is not really presented. The experiments were no doubt labor-intensive and comprehensive, and I can understand that the authors would like to present them in their entirety. I have the impression, though, that the authors were not quite sure about the focus of the manuscript. Title and abstract speak of rapid subsurface flow and identifying preferential flow features whereas in the introduction and then later in the discussion the focus shifts to double-peak hydrographs as if the explanation of these had been the aim of the paper. The abstract does not indicate this. In-between also (multi-modal) transit-time distributions are mentioned several times but surely the experiment was not designed to investigate transit time distributions. The discussion is lengthy and focuses on methodological aspects. At the moment I doubt that the manuscript presents sufficient new data and findings beyond speculations to justify a publication. Maybe it would be an option to combine this manuscript and the mentioned companion paper by Jackisch et al as they present the missing link between processes and structures as stated in the Conclusions, last paragraph.

Specific comments: - P. 2, L 3: preferential flow and rapid subsurface flow are not per se synonyms - P. 3, L 12: if the explanation of double-peak hydrographs is indeed the motivation, this should be mentioned in the abstract - Section 2.1/2.2 and 3.1: I was a little confused that first it seemed to be a study focusing on the irrigation experiment whereas later on also longer-term behavior is described as result. I would only focus on description of the event and potentially, move descriptions of the general hydrological behavior of the catchments to the site description. - Section 2.3.2: I had difficulties to exactly understand the TDR measurements with access tubes and would recommend to describe the soil moisture monitoring more clearly. Could you insert the prongs of the moisture probe via the access tubes in different depths? - P. 8, L 1: predominantly - P. 8, L 6: which three TDR probes? Unclear - Fig. 2: I would not show the location of the piezometers here as you do not discuss any results. That may only be confusing. You can still mention in the text that you installed them but they measured any transient

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water tables. Also, it would help if you could indicate the three diverging transects in the figure. - P. 9, L1: ...transect of 6 piezometers "intended to observe transient water levels"... - P. 9, L 28-29: add numbers of soil moisture profiles here to make sure it is clear to the reader which profiles you are referring to - P. 13, L 1: intensity of irrigation stated here is different to intensity stated in the methods section - P. 13, L 1: when did surface runoff cease? - P. 13, L 4-5: I am not sure what is meant with "overshoot". Is this shown in Fig 4? Please explain more clearly. - P. 15, L 12: I would recommend to make the way times are stated consistent between text and figure (3.3 hours vs 03:18) - Fig. 5: where is the map for TDR 5? And the decreases in soil moisture shown e.g. in the lowest row of profiles is not really discussed in the text. - I do not fully understand how the authors distinguish in the GPR maps between natural event water and irrigation water. Can that be done with the GPR signal? Please explain in a little more detail. - P. 17, L 2-3: is this a speculation or really supported by the results? - P. 17, L 5-6: maybe better say "water that was supplied from upslope areas was more important..." - Fig. 6: there seems to be one map missing of transect 4 in the lower right corner where the legend is located? - P. 22, L 13: agreed instead of fitted - P. 22, L 24-25: again, is this a speculation? - P. 22, L 30: here now it sounds as if the investigation of double-peak hydrographs is the main objective of the paper. This comes as a surprise as it was not mentioned neither in the abstract nor in the title. - I am not sure that from these measurements of soil moisture at discrete points in time lateral flow can really be inferred. - P. 24, L 28-33: I do not think the reasoning here for the high input rates is convincing. I wonder how useful the observed patterns are for more realistic rainfall conditions. - P. 26, L 11: soil moisture should be used with caution as indication for flow, and this has been discussed in the literature before - P. 26, L 19-24: this is not new - Conclusions: I would not mention transit-time distributions here. That surely goes beyond the focus of the paper and may be a stretch to infer. - P. 29, L 14: stable

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