

Reply to general comments of J. Parajka:

The manuscript presents results of four experiments investigating rain percolation through the snowpack and snow melt runoff generation during rain-on-snow events. The rain was artificially generated by sprinkling deuterium enriched water. Contribution of rain and snowmelt on runoff generation was estimated by hydrograph separation technique. The results indicate that rain sprinkling on a colder snowpack had a different water transport dynamics compared to wet isothermal snowpack. Authors conclude that internal mass exchange is an important process for snowmelt runoff generation during rain-on-snow events.

This is an interesting study and worth to publish in HESS. However I also agree with the previous reviews that the clarity of the manuscript will benefit from some revision. I would suggest to make the formulation of title-objectives-results more consistent. The rainwater propagation/contribution/interaction does not have necessarily the same meaning and interpretation. Moreover I missed some more clear formulation of the research hypothesis. What is the main research question and how it can be accepted/rejected by performed experiments. Was there such a clear question prior to the setup of the experiment? Why and how were the four sites/dates selected? The last general comment is related to the discussion part – where it can be considered to add (I missed) some lessons learned section.

We would like to thank Dr. Parajka for his helpful comment.

We will carefully reassess the uses of terms such as “propagation”, “contribution” and “interaction”. “Propagation” is used for describing the transport process of liquid water within the snowpack. “Contribution” refers to the volume of runoff originated in rainwater or meltwater, whereas “interaction” refers to melt/refreeze and displacement processes involving rainwater, liquid water content and ice matrix. Nevertheless, we suggest new title of the paper “Rainwater propagation through snowpack during rain-on-snow sprinkling experiments under different snow conditions”

We intentionally avoided using research hypothesis, as the number of experiments is too small to allow for significance tests needed to accept/reject hypothesis. The main research idea is formulated in P3L9 and is further detailed in three research questions P3L12-14. All questions were formulated prior to the experiments and the experiments were designed according to these questions.

The experimental sites were selected to guarantee sufficient snow depth to conduct the experiments towards the end of snow season. Additionally, reachability/safety reasons/technical feasibility for transport of the equipment limited the choice of possible sites.

We will thoroughly consider your above points when revising the manuscript.

Overall I like the manuscript and enjoyed to reading it. I thus suggest some minor revision.

Reply to specific comments of J. Parajka:

1) Abstract, l.14: the term “advanced hydrograph separation” is not clear here. Please consider to be more specific.

The term “advanced” addresses that the approach employed in this paper additionally accounts for temporal changes in the isotopic signature of the reference values. We will specify this in the revised manuscript.

2) Eq.4. The form of the relationship is not clear. Some reference or more specific information would be useful.

Equation 4 is a newly presented formulation and represents an assumption on how the reference isotopic signature could change during the piston flow effect (Fig. 2 in the manuscript). The tan function governs the shape of the gradual change of the deuterium reference value. It demonstrates that the reference value change is not a step function, but more likely S curve shape or reverse S curve shape (It depends on initial snowmelt and snowpack signature.).

3) Tables/Figures. Please consider to show some more main messages of the paper (presented now in Tables) in the form of figures.

We initially planned to present data in form of figures, but it was difficult to display the same amount of information as in tabular form. Nevertheless, we will consider the reviewer’s suggestion to display at least the main findings from tables 5 and 6 in an additional figure.

4) Figure 4. Please consider to make the x axis longer, to show more clearly the timing. Perhaps the layout 1 column/4rows would be better.

Thanks for this comment which we will implement as suggested (See Fig. 1).

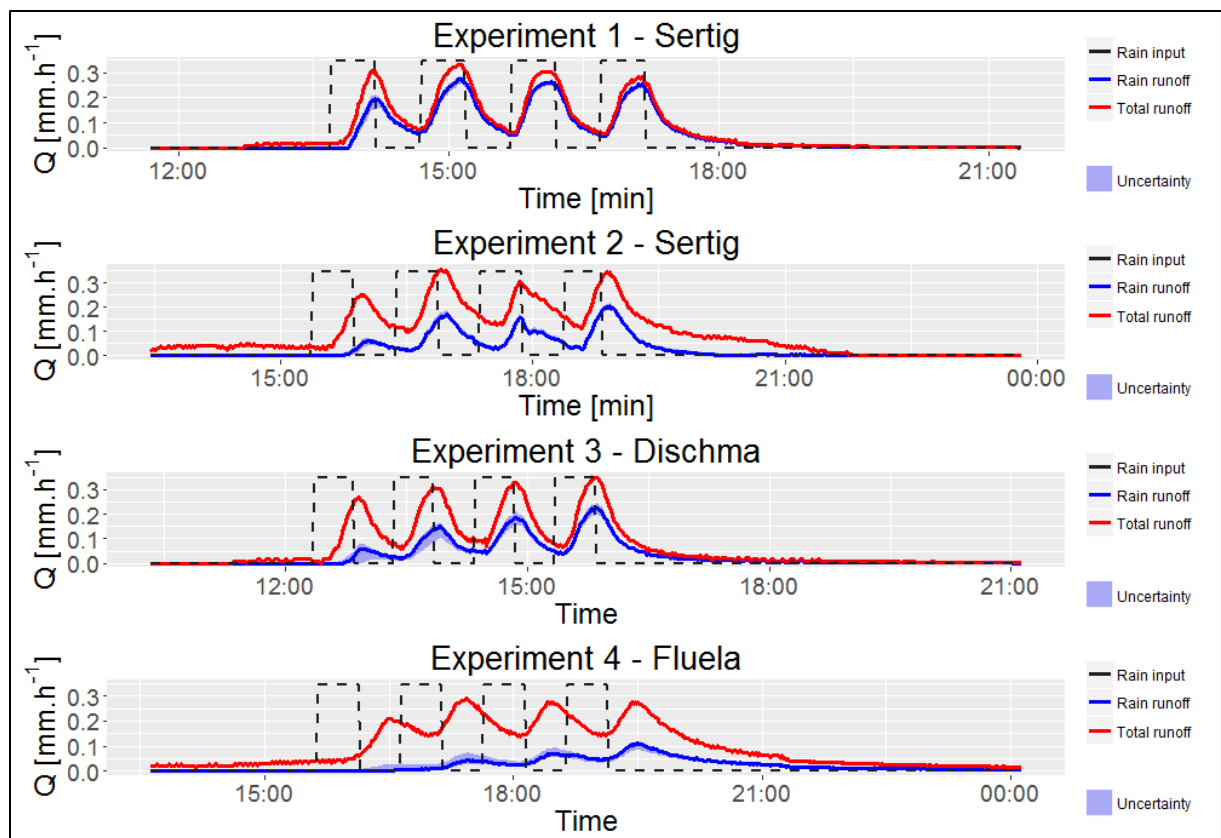


Fig. 1 – An updated plot of experimental runoffs.