Response to reviewer 2, Roman Juras

We thank Roman Juras for revising and commenting the manuscript. We have reproduced those comments below (in normal type), with our responses (in bold).

General comments: The paper presents very interesting and current topic about snowpack out-flow contribution to the catchment outflow during rain-on-snow (ROS) events. The authors identified ten ROS events during two winter seasons, where the effect of snow cover and further snowpack outflow to the stream were analysed. Authors employed two-component hydrograph separation method using natural stable water isotopes and enhanced system of water sampling. I like the study very much, because understanding of the hydrological processes during ROS is still not sufficient and this study aims to contribute to this knowledge. It is an interesting study and worth to publish in HESS. Nevertheless, I recommend to do some minor revisions and I also have a couple of suggestions to improve the study.

My major point to the study is that the authors should present results from the hydrograph separation and provide more information about snowpack outflow composition. Since the isotopic content of rain and snowmelt during ROS events were sampled, the rainwater contribution in the outflow can be easily calculated.

We will include an additional analysis of the rainwater contribution to snowpack outflow in the supplement. However, we want to stress that most events could not be analysed because the pre-event signature of snowpack outflow was not known (i.e., no snowpack outflow occurred before the event).

The authors can also provide the separated hydrograph with all the components.

We will provide the hydrograph timeseries in the revised manuscript.

The authors define in section 2.2.1 the ROS event. Maybe I just missed something, but from this definition it seems that duration of ROS equals duration of rain. This does not match with the values in Tab. 1 (see columns Start time, End time and Rain-fall duration). This issue is also connected with total ROS outflow volumes. Please describe it clearer.

We will clarify the definition of ROS events in the revised manuscript in section 2.1.1.

The Introduction section usually provides in the end some basic goals of the paper. I miss this part in the particular section. Please reformulate the last paragraph (Page 3, lines 30 – 33, Page 4, lines 1 – 3).

We will specify the research hypothesis and the goal of this paper in the introduction.

Although, I am not a native english speaker, I recommend some proof reading regarding the language.

Specific comments:

• Please use elevation units as “m a.s.l.” and not “m asl”.

We will correct this.

• Please present what time zone do you use (UTC, CET, etc.).

We will specify this.

• Figure1: Can you add an information about coordinate system of the map and how far is HG site from the catchment. You should also add a small map of Switzerland, where the study site is located.

A map of Switzerland and information about the distance between the HG site and the MG site/catchment will be added in the revised manuscript.

• Lot of technical information regarding the field monitoring system is provided (page 5, lines 15 – 18, page 1 – 5). It would be beneficial to better readers clarity if you present these information in tabular form. The sketch or photograph of the monitoring system would be also very practical and provide better view how the system works.

An earlier paper:

Rücker, A., Zappa, M., Boss, S. and von Freyberg, J.: An optimized snowmelt lysimeter system for monitoring melt rates and collecting samples for stable water isotope analysis, J. Hydrol. Hydromechanics, 67(1), 20–31, doi:10.2478/johh-2018-0007, 2019.

provides a detailed description of the field monitoring system. We have only included this reference in the manuscript in order to shorten the methods section.

• If you state just water stable isotopes as such, do not use δsymbol, but only ^{2}H and ^{18}O (Page 3, line 3). Delta symbol refers to some defined standards.

We will change this in the revised manuscript.

• You mention that the snow was sampled by a snow tube (Page 7, lines 27 – 28). Do you use any standardised tube? What is the material of the tube?

We did not use a standardized tube; the tube was custom-made at WSL from from glass fibre with epoxy resin and edges made of steel.

• Please be consistent with presenting the time intervals. You often mix numbers and text information, like 10-minute x ten minute (i.e. Page 7, lines 7, 9).

We will correct this.

• Page 16, line 1: According to Fig.2 the snow depth at HG does not look 97 cm deeper than MG.

This was a typo, we intended to present this number as a depth of the HG snowpack and not as the difference between the HG and MG snowpack depths.

• Page 16, line 14 – 15: Do you have any isotopic signature results of the through fall? Can you compare it with rainfall on the open sites?

During the observed winter 2016/17, we did not explicitly sample throughfall at the forested site.

• Page 18, line 2: How did you estimate the cold content of the snow? Did you also measure the snow temperature or did you just guess it from the air temperature? If you consider just mean air temperature, how long prior to the event? Maybe you should rather use cumulative

temperature from last x hour. Nevertheless, this statement is quite tricky, because the higher cold content does not always mean that more incoming rainwater is stored in the snowpack. Water storage is more related to the snow stratigraphy and layering.

Thank you for this thought, we will implement this into the revised manuscript.

• Figure 4: Can you add r^2 values to all subplots?

This will do this.

• Page 20, line 4: How do you define lag times?

We will specify lag times in the revised manuscript:

Lag time is the time between the beginning of the ROS event and the first response of the snowpack outflow; the first response is defined as an increase of snowpack outflow by at least 0.05 mm relative to the previous measurement.

• Page 20, line 6: How do you estimate saturation of the snowpack?

We did not directly measure saturation of the snowpack, however, we assume that the snowpacks at the MG and HG sites were ripe prior to event #6 because snowpack outflow volumes were continuously above 0.05 mm during the previous days. This explains why the snowpack outflow volumes immediately increased with the onset of the ROS event.

• Table 3: What does represent the last column (Rainfall MG) of the table? There are used two terms in figure 6 –rain and rain-on-snow. Please be consistent with the naming.

We adapt these terms in the revised manuscript.

There are presented results of different water contribution to the catchment outflow only during peak discharge. Can you also present results of outflow composition from the entire event period?

We will include the plots of the hydrograph separation results in the revised manuscript or supplement. In addition, we will provide the hydrograph separation results (during peak flow and during maximum contribution of snowpack outflow to streamflow) as a table in the supplement.

References

Claassen, H. C. and Downey, J. S.: A model for deuterium and oxygen 18 isotope changes during evergreen interception of snowfall, Water Resour. Res., 31(3), 601–618, doi:10.1029/94WR01995, 1995.

Dewalle, D. R. and Swistock, B. R.: Differences in oxygen-18 content of throughfall and rainfall in hardwood and coniferous forests, Hydrol. Process., 8(1), 75–82, doi:10.1002/hyp.3360080106, 1994.