Response to the interactive comment of Reviewer#3

on "Studying catchment storm response using event and pre-event water volumes as fractions of precipitation rather than discharge" by Jana von Freyberg et al.

General comments:

The authors propose a new approach to characterize the catchment response of a pre-alpine mountainous catchment Erlenbach, in Switzerland. They measured high-resolution precipitation and stream flow isotopic data to calculate pre-event and event water fractions based on precipitation instead of discharge, as commonly used. A large number of storm events (24 events, in total) are analysed combined with, for example, antecedent moisture conditions in the catchments. The results shown in this study underline their potential to a new "fingerprint" of catchment responses. With respect to the transferability of these results, it is clear that a cross comparison study is needed, as it is already mentioned in this study. However, I recommend to extend the remarks on whether this fingerprinting approach might hold also in other catchments and to hypothesize which requirements would need to be fulfilled (catchment characteristics or climate such as mountainous, specific land cover proportion, temperature climate and so on). Besides, the manuscript is written in a concise way and in good English quality. Some figures deserve further attention regarding additional information in the caption or their readability. To conclude, only minor revision is needed for this study to be accepted in Hydrology and Earth System Sciences.

We thank the reviewer for his/her assessment and his thoughtful comments, which we have addressed in detail below.

Comments of the reviewer are shown in italics. Responses from the authors are presented in regular font below each comment. Citations from the manuscript are in Times New Roman and changes of manuscript text are underlined.

Specific comments:

Page 1, Line 14: At this point, it is not clear for the reader if event- averaged fractions or instantaneous fractions are used. Please clarify.

The ratios Q_e/Q, Q_{pe}/Q, Q_e/P, Q_{pe}/P, and Q/P were calculated from the cumulative volumes of event water (Qe), pre-event water (Qpe), total discharge (Q=Qe+Qpe) and precipitation (P) aggregated over the storm period. Instantaneous values were denoted with an index i, as pointed out in Sect. 2.4.

We will be more explicit in the revised Abstract to emphasize that our analysis is based on cumulative volumes (mm) and not on instantaneous rates (mm/h).

Page 8, Line 5: Is it correct that the average isotopic composition is taken from the period of time of 2,5h prior to the storm event? This information could be added here in parenthesis, for example.

Yes, this is correct. However, if a check standard was sampled within this period, the time span became 3 hours. We will add this information in Sect. 2.4 in the revised manuscript.

Page 10, Line 3: If your data analysis starts 6 May 2017, the effect of snowmelt on the isotopic composition of the stream water is still present and should be considered when discussing May and June storm events (for example, 13 and 19 May 2017 events). Both events occur after intense snowmelt infiltration into the stream (see Figure 2).

We agree with the reviewer that the more isotopically depleted streamwater in early-mid May might reflect snowmelt contributions. However, to the extent that snowmelt inputs will contribute to both pre-event water and event water, they are not likely to exert a substantial effect on the hydrograph separations. This is particularly the case because the isotopic composition of incoming rainwater during those May and June events used in our analysis was very distinct from that of pre-event water stored in the catchment (see detailed time series plots in the Supplement Material), and the bulk snowpack sampled in the catchment (which will be presented in an upcoming paper). Measurements from snowmelt lysimeters (which will also appear in an upcoming paper) also show that the isotopic composition of the water leaving the snowpack

during these events was dominated by recent precipitation (in the upper part of the catchment, which still had some snow cover in May). Thus, despite the strong seasonality in the streamwater isotopic composition, we believe that the two-component hydrograph separation results provide reasonable estimates of event- and pre-event water volumes.

Page 10, Line 10: Which technical problems occurred with the automatic sampler? However, it is not necessary to report these details in the manuscript.

The automatic sampling routine was programmed in the MagICNet software of the ion chromatograph (IC). Thus whenever there was a technical problem with the IC, the sampling routine (which also fed the isotope analyzer) was interrupted (von Freyberg et al., 2017).

von Freyberg, J., Studer, B., and Kirchner, J. W.: A lab in the field: high-frequency analysis of water quality and stable isotopes in stream water and precipitation, Hydrol. Earth Syst. Sci., 21, 1721-1739, 10.5194/hess-21-1721-2017, 2017.

Page 14, Line 2-3: Please remove the first "not".

Thank you for catching this error. We will correct that.

Page 18, Line 4: Qini in Figure 7 is not displayed in log-scale

We will update the tick marks of the Q_{ini}-axis in the revised version of the manuscript.

Page 18, Line 16-18: Please discuss further whether these 'fingerprint' may result from the specific catchment characteristics of Erlenbach catchment and how strongly they are connected to the catchment land cover.

Because our data set was collected at only one catchment, we should not speculate about the role of the catchment characteristics in the fingerprints discussed here. For this, a similar analysis needs to be carried out at sites with different landscape and climatic properties – which we point out at the end of the paragraph.

Synthetic results from a benchmark model show that different parameter values result in different fingerprints (Kirchner, 2018), suggesting that the relationships observed for Erlenbach might not be universally applicable, and, on the other hand, that these fingerprints may vary substantially in response to variations in site characteristics. But because we have real-world data from only one site, we cannot yet say how Erlenbach's "fingerprints" might compare to those observed elsewhere.

Kirchner, J.: Quantifying new water fractions and transit time distributions using ensemble hydrograph separation: theory and benchmark tests, Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-429, in review, 2018.

Table 1: the last date entry of column 1 is '29Ot2017'.

The last entry was actually '29Oct2018', which we will correct to '29Oct2017'.

Figure 1: Please enlarge map symbols and make labels more visible (using a different colour and fontsize, for example). Please correct 'The Erlenbach. . .' in the caption.

We will change that.

Figure 2: Although these events are not considered for your analysis, please mention the remaining events, during which isotopic stream composition remarkably drops (snowmelt events?)

These are not snowmelt events. As explained in the text, they were not analyzed because there was not a clear isotopic separation between the event and pre-event water, so the event water contribution could not be reliably determined using hydrograph separation.

Figure 3: On which criteria is the selection of events displayed here based? Please report.

We picked 16 events with the most diverse peak flow rates. For the sake of readability, the remaining eight events are not included in the graph because they share very similar hourly peak flow rates to those events depicted in Fig. 3. We will add this information to the caption of Fig. 3.

Figure 5: Could you add errorbars in this graph?

Due to the high-resolution isotope data, the standard errors of the cumulative volumes of Qe and Qpe are very small – typically much less than one mm (Table 2). Therefore, the error bars in Fig. 5 would often be too small to be visible. We will include an information about the relative errors of Qe and Qpe in the caption of Fig. 5.

Figure 7: Axis labels and tick labels are very small and difficult to read. Please enlarge here to improve readability.

We will change that.