Please find below our responses to the comments by the anonymous reviewer RC2. Our responses are given in blue, and text that will be added during the revision is underlined.

The study by Knapp et al. investigates how precipitation intensity and antecedent wetness differently affect catchment hydrological response and transport. Using sub-daily hydrometeorological data and stable water isotopes in two catchments in Europe, the authors give evidence that hydrological response (streamflow reaction to rainfall) is much faster than transport (movement of precipitation to the stream). They find that increased antecedent wetness strengthens runoff responses by mobilizing older water, whereas higher precipitation intensity accelerates runoff signals and delivers more recent precipitation to streamflow. These findings provide insights into runoff generation, flow paths, and water sources.

The paper is written well and concise. The applied methodology and its findings are novel in will certainly contribute in advance catchment research. Some suggestions for minor revision in the following.

We are grateful to RC2 for the positive evaluation of our work.

Introduction:

I think the "old water paradox " needs to be presented in a bit more detail. It is indeed not as detailed as what this study is about to present but it is worth mentioning that it has been known for a very long time that hydrodynamic responses have been found to be much faster than hydrogeochemical responses (by different tracers, often using end-member mixing analysis or similar)

As I remember the discussion of some of these studies, there were more possible explanations for this behavior. Wetness, but also something called transmissivity feedback, and the possibility, that unsaturated (but almost saturated) zones become saturated and all the "old water" that was previously immobile, becomes mobile again, e.g. in the riparian zone. Maybe these explanations could also be mentioned and possibly discussed.

Agree. We will add the following text to the introduction to further explain the old water paradox and the differences in hydrodynamic and hydrochemical response timescales: "*This "old water paradox" has been recognised for several decades (e.g. Małoszewski and Zuber, 1982; Rodhe et al., 1996; Weiler et al., 2003) and describes the discrepancy between the fast hydrological response to precipitation and the much slower hydrogeochemical response, indicating that streamflow is primarily composed of older subsurface water rather than recent rainfall.*"

Site descriptions and datasets

These two subsections are relatively short, which makes sense. But since differences of the two sites will be discussed later, it would be helpful seeing a direct comparison of their main characteristics in a table

We politely disagree. Relevant site characteristics are included in the text. The main findings of our research suggest that the two sites exhibit broadly similar behaviour, i.e. that the behaviour is potentially independent of catchment characteristics. Hence, we think that adding a table which emphasises catchment characteristics would distract from this general behaviour and could falsely create the impression that this is about site-specific behaviour instead.

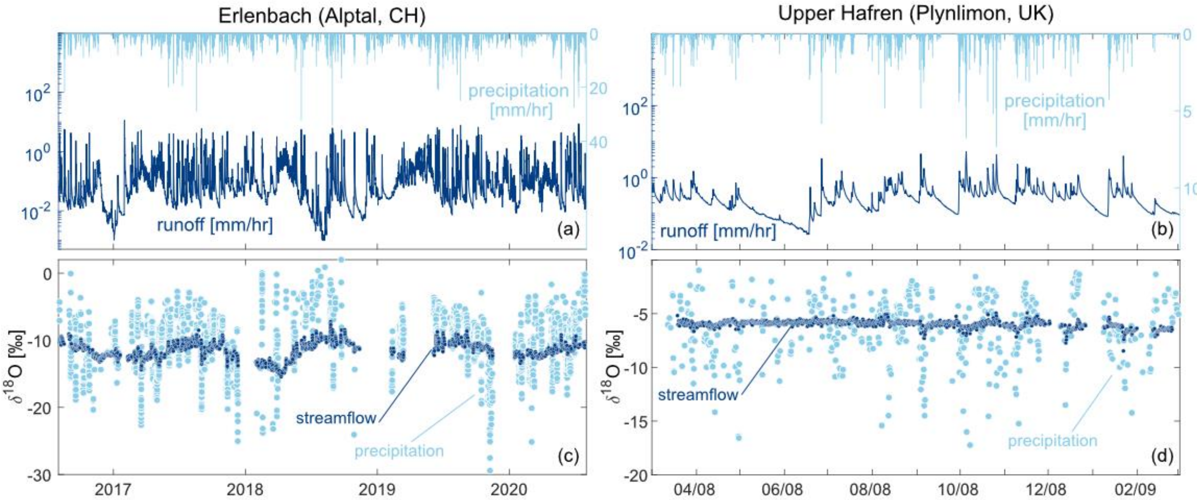
Data analysis

Wetness quantification: it seems that wetness is considered to be related to the mobile storage, which is considered to be in relations with discharge. This would disregard wetness in the soils or the unsaturated zone, right? If so, please clarify. I think this might also be a possible reason why changes in antecedent wetness do not have an apparent effect on shallow flow paths. It might, if you quantify it differently (e.f. subsurface storm flow doesn't require saturated conditions, so the wetness metric of this study wouldn't be a good proxy for it)

We consider antecedent discharge as a measure of wetness. While we acknowledge that this does not directly capture soil wetness in the unsaturated zone, we deliberately chose this metric because antecedent discharge provides an integrated measure of catchment-wide wetness. In contrast, soil moisture measurements are often spatially limited to specific locations and may not fully represent the overall wetness state of the catchment. To clarify this point, we will add the following sentence to the manuscript: "*This approach of assessing antecedent wetness ensures that our wetness metric provides a more holistic representation of catchment-wide wetness compared to localised soil moisture variations*."

Figure 1: if space allows it, it would be good seeing both subfigures beside each other (discharge/P and isotopes of both catchments besides each other)

Agree. We will change this as suggested:



Subsection 2.3.3: in addition to the equation some explanation should be give on why backward and forward new water fractions are calculated and how they can be interpreted. This is well done in 3.4 but could be mentioned already up here.

Agree. Section 2.3.3 already contains the following explanation of the backward and forward TTDs: "The forward TTD determines the relative proportion of precipitation that contributes to streamflow within specific time intervals, while the backward TTD quantifies the proportion of streamwater that consists of water of different ages (Figure 2 b, d)." We will add the following: "*Their definition corresponds to the definitions of the backward and forward TTDs, with backward new water fractions quantifying the relative amount of streamflow that consists of precipitation that is "new" during the interval since the previous water sample, and forward new water fractions quantifying the proportion of precipitation that became streamflow during the same interval.*"

<u>Results and discussion</u>

I think it would be worth clarifying what the term "infiltration" is meaning in this study as it seems that it is used to describe infiltration into the groundwater storage/aquifer, which is often referred to by "recharge". I assume that the authors had good reasons to speak about infiltration rather than recharge (or storage, rather than aquifer) but it would be good mentioning this early in the manuscript.

We use the term infiltration rather than recharge in Fig 6 because our focus is on the precipitation perspective rather than groundwater storage (i.e. "where does precipitation go?" rather than "how are subsurface water volumes changing?"). The term recharge is more commonly associated with groundwater (storage) dynamics and refers to water reaching the saturated zone, which we do not explicitly assess here.

I very much like figure 6! But it also made me think how much it adds to the knowledge compared to the pre-event water / event water studies that have been published in the past. The methodology and datasets of this study are new and unique. In the results section the authors reveal very differentiated insights over hydrodynamics and transport dynamics over a large number of events. I think, if this differentiated information could be somehow added to this figure or be added to the general take-home message of the paper, it would be even more appealing to read it.

We thank RC2 for the positive evaluation of our figure 6. We appreciate the point about how our study builds on and extends previous work. We will modify and clarify the take-home message by emphasising the detailed insights our results provide on hydrologic response and transport dynamics by adding the following at the start of the discussion: *"This study builds on previous research by providing a more detailed view of hydrological and transport dynamics across a large number of events. Our findings highlight how catchment wetness, flow pathways, and solute transport vary under different conditions, offering a more nuanced understanding of catchment responses."*

Finally, in a volume not too excessive, it would also be great to discuss the spatial domain to which the perceptual model in figure 6 could be applied when thinking beyond hillslope scales, and to which types of aquifer it may be most applicable to. Especially in flat terrains and for larger catchments, only regions closer to the stream show such obvious behaviour. I am wondering about it as it brings up the question how well groundwater models and surface models should be coupled and whether lumped or distributed schemes ar most adequate to accommodate the observed processes.

This is an interesting idea and we thank the reviewer for raising this comment. However, we think this is beyond the scope of this study and goes beyond the interpretability of the dataset. We therefore only add the following sentence to the Discussion: "*The spatial scales of these processes may depend on catchment characteristics, such as slope and topography*".