Authors' response to Reviewer 2 [hess-2025-1530-RC2]

We thank the reviewer for his evaluation of our manuscript and his many helpful comments (hess-2025-1530). Below we address the reviewer's comments (full text) indented by arrows and coloured in blue. We appreciate the efforts by the reviewer, which will help to improve our manuscript.

General comments

Section 2.5 clearly outlines the EHS method, but its reliance on equations may pose difficulties for readers unfamiliar with isotope-based hydrograph separation. I recommend adding a simplified conceptual diagram or schematic to illustrate the EHS workflow.

→ We acknowledge that it might be difficult to understand the EHS workflow from the equations we provide, especially for readers unfamiliar with isotope-based transit time estimations. However, one must consider that this paper will primarily target an audience well-familiar with these techniques – other readers will be more interested in the conclusions we draw based on EHS. This is why we think that this manuscript will not necessarily benefit from the addition of such an illustration, also because the EHS methodology is already well documented in Kirchner (2019) and Kirchner and Knapp (2020). Note that a scatter plot of $C_{Q,j}$ - $C_{Q,j-1}$ versus $C_{P,j}$ - $C_{Q,j-1}$ with the regression line representing the fraction of new water F_{new} is presented in Kirchner and Knapp (2020), which is a very good introduction to the EHS framework.

I recommend that the authors provide a brief rationale or literature-based justification for choosing the 16-day threshold as the representative time scale for defining "new water." It would also be helpful to clarify whether and to what extent this threshold might influence the interpretation of the results and the robustness of the study's conclusions.

→ Thank you for the suggestion, the answer to your comment overlaps one of our answers to reviewer 1: the fortnightly sampling limits the Fnew interpretation in terms of fast-response components, which can represent an issue in particularly reactive streams, e.g., in impermeable layer catchments with hight contents of marls or claystone. During high streamflow events, much of the hydraulic response will occur within that two-week window timeframe, which would be interesting to investigate at higher temporal resolution. Once either the infiltration capacity or the storage capacity of the soils in these catchments has been reached, overland flow processes can occur very quickly, within hours or even minutes. This could be essential for studies focusing on trigger mechanisms of intense short-term events, such as flash floods caused by highly intensive convective rains. This study could serve as a guide to identify streams that would benefit from high-frequency sampling or monitoring campaigns. We will make sure to include this aspect in the discussion.
As to why the 16-day threshold was chosen for defining "new water", the 13-year record of isotopic measurements must be put in its original context. When the sampling started, EHS had not yet been developed and instead studies would rely on metrics such as the mean transit time, derived from convolution or sine wave fitting approaches. We briefly mention these techniques in the introduction:

"However isotope-based studies have often relied on convolution or sine wave fitting approaches that are not well suited to capture the spatial and temporal heterogeneities that dominate streamflow generation in most catchments (Kirchner, 2016a, b). A common source of bias is a priori conjectures concerning the shape of the TTD (Remondi et al., 2018), resulting in, e.g., increasing uncertainty in mean transit time (MTT) estimates when MTT exceeds several years (DeWalle et al., 1997). More recently, calculations of the fraction of young water (Kirchner, 2016b) and transit times

extracted from storage selection functions (SAS) (Benettin et al., 2015; Harman, 2015; Rinaldo et al., 2015) have been proposed as more robust methods than traditional MTT estimates."
Often, monthly data would suffice to calculate metrics such as the fractions of young water, i.e., water travelling to the steams in less than 2-3 months (Kirchner, 2016), e.g., as has been done in analogous inter-catchment studies in Germany (Lutz et al., 2018) and in Switzerland (Von Freyberg et al., 2018), relying on fortnightly to monthly isotope data. Hence, for the techniques of the time, fortnightly isotopic measurements in multiple catchments were already state-of-the-art, high-resolution datasets. In this context, moving from the previous definition of fractions of water less than 2-3 months to fractions of water less than ~16 days old is already a considerable step. Of course, it would be advantageous to move to higher frequencies in catchments identified here, which we will consider for future investigations.

The assumption of a 200 mm threshold for field capacity warrants further clarification. I recommend that the authors briefly justify whether this value reflects region-specific soil and climatic conditions, and whether it is based on measured soil data or literature from comparable settings. Clarifying this point would enhance the robustness of the catchment storage estimates.

→ Again, thank you for the suggestion. For the threshold of 200 mm for the field capacity, we can refer to Pfister et al. (2017), as they have already done these storage calculations for the same catchments in the past, but for shorter periods. They assessed the sensitivity of the storage estimates to different values of the field capacity (100, 200, 300 mm) and found the daily offsets to be largely unaffected by the value chosen for the field capacity. Consequently, although the absolute storage estimates might differ, the storage deficit, ultimately used in this study, remains unchanged.

Please note that the abbreviation "i.e." appears redundantly in both line 163 and line 253. Please delete the redundant "i.e.".

→ Thank you, we will remove it.