

Reply to Referee #2

We appreciate the helpful comments of the reviewer. Please, find below in black the comments of the reviewer and in blue font how we will address each comment and suggestion in the revised manuscript.

General Comments:

This article investigates the relationship between the stable water isotopic composition of throughfall relative to drop size. The article is well-written and has practical implications for understanding the evolution of isotopic composition as it moves through the forest canopy. The strengths of this manuscript are the high temporal scale at which the measurements were taken and the number of events which were sampled. The weakness is the single throughfall sampler. However, in this way, any variation in the measurements could be attributed to storm characteristics and not to variation among trees. To this end, I think the manuscript is of interest to the HESS readership and could be accepted following minor revisions.

Response: We appreciate the overall positive assessment of our work.

Specific Comments:

Line 95-97: Please cite the data source for the climatic data.

Response: The climatic data was calculated from the meteorological data collected by the authors in the Vallcebre research catchments. The reference Llorens et al. (2018) will be included.

Line 107: Why were the distances of 0.82 and 1.15 m selected? How was the individual tree selected?

Response: We will clarify both questions in the manuscript as follows: “The rainfall monitoring site was located in an open area approximately 100 m from the Scots pine stand where throughfall was monitored (Fig. 1). The study tree is representative of the forest plot and has a canopy projected area large enough to locate the throughfall instruments. Throughfall was monitored at two randomly selected distances (0.8 and 1.2 m) from the bole of the study tree (Table 1)”.

Equation 2: OP_i was not defined. Can you explain why the assumption of “ p is the maximum value under the condition $(\text{Fri}-pOP_i) > 0$ ” works?

Response: Thank you for the comment. We will define OP_i and clarify the assumption as follows: “where OP_i is the class i of open rainfall and p is the free throughfall fraction (dimensionless, from 0 to 1), which is related to canopy openness. Raindrop impact on the canopy and/or wind and turbulence can cause the canopy to sway during rainfall events, triggering dynamic variation in the degree of canopy openness. Because it is difficult (or impossible) to determine actual p , an approximation of p was assigned as

the maximum value under the condition $(FR_i - p OP_i) > 0$, utilizing the same protocol as Nakaya et al. (2011). This protocol might overestimate p .”

Line 164-165: How can splash throughfall be drops with diameter < 1 mm but the maximum splash diameter is 2 mm?

Response: To clarify this item, we will reword the sentence: “Splash throughfall is smaller than canopy drip. We set the maximum splash throughfall diameter (D_{MAX_SP}) at 2.0 mm and the minimum canopy drip diameter at 1.0 mm, respectively. It indicated throughfall drops with diameter (d_i) from 1.0 to 2.0 mm were generated from the mixture of FR, SP, and DR.” (L. 171-173)

Section 2.4: What time step were the samplers programmed to collect water? Section 2.2 says the tipping buckets recorded every 5 minutes, but were the water samples partitioned into separate collectors for isotopic analysis every 5 minutes too?

Response: Thank you for pointing this out. Automatic samplers were set to collect samples every 5 mm of rainfall, whereas the datalogger recorded the tipping-bucket data every 5 minutes. We will clarify this difference between data measured by the tipping-buckets (time) and collected samples (volume) in the manuscript.

Figure 5 seems to show isotopic data at non-standard intervals during each storm.

Response: Isotopic data depicted in Figure 5 correspond to intervals of 5 mm of rainfall. For that reason, there are different time intervals between samples. We will include a clarification in the caption of figure 5.

Line 209: Provide percent partitioning of max throughfall 48.3 mm event in parentheses.

Response: We will add this information.

Lines 241-259: Both of these paragraphs could be improved by adding in quantitative data of the % differences. For instance, how much lower was the free throughfall in long duration-low intensity rainfall events? They could also be improved with figures or tables summarizing the data presented.

Response: We agree that adding quantitative data of the % differences could be useful to summarize the data we presented. We will add a table with the percentages as part of the Supplementary Material.

Line 287: The 6 hour drying time will probably evaporate all the water stored on leaf surfaces, but there is almost certainly pre-event water stored in bark tissue that could mix/exchange with the next event. Please address this possibility in the text.

Response: We appreciate this suggestion. According to Llorens et al (2014), in the same study area (with oaks) after the rainfall events, the canopy from 3 m above ground to the top was dry after 6 h during the day and 12 h overnight. Taking into account that these drying times are reasonable for the plot studied, we separate the events in this work. We agree that there is a possibility that the tree boles (2-3 m above the ground) will be wet longer. Although this could have an implication for the

stemflow isotopic composition, we consider that this would not influence the throughfall isotopic composition.

Line 305-309: I'm not clear on what the authors are explaining here. Why would there be pre-event water in the sample bottle? Can the authors also remind the reader in the text what the time-step was at which the first and second samples were collected?

Response: The samples were collected every 5 mm of rain, but the bottles of the automatic samplers were collected every week. Therefore, if for example two events occur during a week, it may happen that the water from the last sample of the first event (in case it does not reach 5 mm) mixes with the water from the first sample of the second event. These mixed samples were discarded from the analysis.

Line 364: What are the multiple factors/variables?

Response: Following the reviewer's recommendation the sentence will be improved as follows: "The most likely scenario is that a combination of rainfall characteristics, meteorological variables and isotopic fractionation factors exerted influence on the isotopic fractionation observed in the canopy."

Lin 368/Fig 6a: Are all the datapoints in the first boxplot (<0) of values between -1 and 0 (i.e., of similar distance for the bin compared to the other bins)? The sentence prior to this one says "some significant trends were observed". Was the isotopic shift in the <0 bin statistically significant? If so, indicate in the text and on the figures. If not, please remove the word "significant" from the sentence on Line 367.

Response: The first bin in Fig. 6a corresponds to the interval -1.2 to 0. Then, we choose to group it as (<0). Thanks for the indication, we will remove the word "significant".

Line 369-370/Fig 6b: Did the isotopic shift decrease with rainfall or did it just become less variable?

Response: Both, the isotopic shift slightly decreased and become less variable with increasing cumulative rainfall. We will clarify the sentence in the manuscript.

Line 377/Fig 6d: In line 374-375 you said there was no clear relationship but here you say there was above the threshold of 300 J/m². Again, can you really say the shift decreased beyond this threshold or did it become less variable?

Response: Following the recommendation, we will delete the incoherent information from the text in Line 377.

Line 421-422: Without statistical analysis, it's not appropriate to say these trends were observed in the data. See previous comments.

Response: We agree, and we will modify the sentence to not be interpreted as statistically significant.

Technical Corrections:

Line 93: Scot pine should be "Scots" pine

Response: We will fix it.

Line 102: inconsistent number of decimals

Response: We will fix it.

Line 260: Here the abbreviations “S-L” and “L-L” are used but in most other instances in the manuscript the full description is written out. Pick one format and be consistent.

Response: We checked the manuscript for consistency, and we use the full description in the text and the abbreviations only in brackets.

Line 415: avoid using “showed” twice in this sentence

Response: We will fix it.

Fig 7: “,” should be “.” in number formatting

Response: Following the recommendations, we will change “,” to “.” in Fig. 7.

References:

Llorens, P., Domingo, F., Garcia-Estringana, P., Muzylo, A., and Gallart, F.: Canopy wetness patterns in a Mediterranean deciduous stand, *J. Hydrol.*, 512, 254-262, <https://doi.org/10.1016/j.jhydrol.2014.03.007>, 2014.

Llorens, P., Gallart, F., Cayuela, C., Roig-Planasdemunt, M., Casellas, E., Molina, A. J., Moreno-de las Heras, M., Bertran, G., Sánchez-Costa, E., and Latron, J.: What have we learnt about Mediterranean catchment hydrology? 30 years observing hydrological processes in the Vallcebre research catchments, *Geogr. Res. Lett.*, 44, 475-501, <https://doi.org/10.18172/cig.3432>, 2018.