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# *Interactive comment on* "Technical note: An improved discharge sensitivity metric for young water fractions" *by* Francesc Gallart et al.

**Francesc Gallart et al.**

francesc.gallart@idaea.csic.es

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We thank the reviewer for the comments and suggestions she/he made. Most of the reviewer's suggestions focus on how the concept of young water fraction and its discharge sensitivity can be applied to analyse the hydrological functioning of the catchments; however, such analyses would go beyond the scope of a technical note. Nevertheless, we will respond to all comments below and make the opportune changes in the manuscript.

(i) When comparing catchments that are characterised by very contrasted climates (as it is the case here), it would be helpful to have more information on the hydrometeorological context. For example, annual precipitation vs annual discharge, a flashiness



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index (e.g. as per Holko et al., 2011. doi:10.1016/j.jhydrol.2011.05.038) would equally be helpful in this context. A plot showing how stream water samples taken for isotope analysis are distributed along the FDC would also be very informative.

Response: Following this suggestion, several more hydro-climatic indices will be included in Table 1 in the revised manuscript for easier comparison with the catchments studied in von Freyberg et al. (2018) and elsewhere: Annual precipitation and discharge, average precipitation intensity and quick flow index. At Can Vila, where the streamwater sampling frequency increased as a function of discharge, more information on the time exceedance of recorded and sampled discharges will be added. More information about the hydro-climatic properties of the Can Vila catchment is available elsewhere and the relevant publications will be cited.

(ii) In equation 6, the parameters Fo and Sd are obtained via fitting a sinusoid function to the seasonal variation of the isotopic signal in stream water Cs(t). In this context, it would be interesting to further investigate and discuss if and how the catchment's wetness state (changing across seasons, but also from one rainfall event to the next) may influence the hydrological functioning of the studied system – and subsequently also the discharge sensitivity of the young water fraction. Soil moisture measurements (if available) or a (daily) water balance calculation could be helpful in this respect.

Response: We agree that these comments would be relevant for analysing the hydrological functioning of the catchment, which is, however, not the scope of our technical note. The technical note is intended to improve a metric primarily designed for describing the time-aggregated response of the catchments.

(iii) Along similar lines, are there any conclusions that can be drawn as to which reservoirs/ compartments actually contribute to streamflow? Did the authors explore to what extent the intensity of precipitation events may influence hydrological responses – and trigger for example similar peak discharge for events that had different initial wetness states. Moderate rainfall may trigger high discharge when the catchment is already

close to saturation; likewise, very intense precipitation may trigger similarly high discharge when the catchment has not yet reached saturation. In one case we may have saturation excess overland flow, as opposed to infiltration excess overland flow. How would this influence results and conclusions drawn on the discharge sensitivity of the young water fraction? How much would this also impact any potential catchment intercomparison between catchments with contrasted climate characteristics?

Response: These comments are relevant for extending the application of the young water fraction concept to the analysis of the hydrological functioning of catchments. For our technical note, we utilized the Can Vila data with the intention to demonstrate the limitations of a linear discharge sensitivity of Fyw and to develop an alternative approach. An analysis of the hydrological processes that are responsible for the observed discharge sensitivity in Can Vila would go beyond the scope of the technical note.

(iv) One of the main conclusions of the manuscript is that there is a need for sampling intensively the largest possible range of discharge values along the flow duration curve – with a special focus on (very) high flows. Considering potential hysteretic patterns in the rating curves, how would they impact the sampling protocol and subsequently the conclusions drawn from the obtained data? Is the dataset available for the Can Vila catchment (spanning a wide range of discharge values for O and H stable isotopes in stream water) offering the possibility to investigate this question?

Response: Indeed, the need for high-frequency stream water sampling is an indirect conclusion of our analysis, more widely analysed in Gallart et al. (in review). But this issue is partly offset by the fact that the new exponential Sd metric is much less sensitive to the largest sampled discharges than the original linear DS(Q). At Can Vila, the rate of sampling was higher during the rising limb of the hydrograph than during the falling limb because the discharge increase was much faster than during recession. This opens the possibility to investigate the potential hysteresis in the rating curve, an interesting question not yet attempted.

(v) Possibly, the authors could conclude their work by stating one or two hypotheses that they may consider as being important to be tested in future work (for example in other physiographic contexts).

Response: Following this comment we will include some open questions directly related to the role of the sampling design in robustly determining Sd and Fyw, as well as whether Sd, F0 and Fyw are correlated with each other when diverse catchments are compared.

Gallart, F., Valiente, M., Llorens, P., Cayuela, C., Sprenger, M., Latron,J.: Investigating young water fractions in different hydrological compartments of a small Mediterranean mountain catchment: both precipitation forcing and sampling frequency matter. Hydrol. Process. (in review)

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