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

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Responses to referee #1

We thank this referee for the fair and useful comments she/he made. We have addressed all comments for improving the clarity and soundness of the paper.

L66. What is the precipitation distribution in year? Would it be possible to show small graph of the annual precipitation and discharge? This would give readers an easy way to get a feeling of the study catchments compared to other catchments.

Response: Because our manuscript is a short technical note that does not focus on a scientific analysis of Can Vila's hydrological properties, in response to this comment we decided to include a sentence on the precipitation and runoff regimes of the Can

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Vila catchment along with some additional hydro-climatic indices in Table 1. Furthermore, two publications in which Can Vila's climatic and hydrologic properties have been described previously will be cited.

L70. mentions that sampling was done at maximum discharge of 404 mm/day. Caption of Figure 1 mentions that maximum sampled discharge was 226 mm/day.

Response: The maximum recorded discharge was 404 mm/day. However, the maximum discharge that was actually sampled was substantially smaller (226 mm/day). This will be better explained in the revised manuscript to avoid any misunderstanding.

L72. Was sampling done for rising and falling discharges? It would be interesting to see if there is hysteresis in the ywf and the high-frequent sampling might be suitable for this analysis.

Response: 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 during the first. This technical detail will be explained better in the revised text. The possible hysteresis is an interesting question not yet investigated.

Figure 1. If I understand correctly the 'Median discharge' in Figure 1 means the median discharge on the sampling day instead of the discharge at the exact moment of sampling? So all samples are in the figure, while the actual maximum/peak discharge at the moment of sampling on these days was 226 (or 404) mm/day. The authors could consider clarifying this.

Response: Discharges were measured at the time of sampling and were not aggregated but simply transformed into daily flow units for easier comparison with other studies. For our analysis in Fig. 1, we only used those discharge values (in mm/day), during which water samples were collected. Then, the "Median discharge" in Figure 1 is the median value of sampled discharges for each flow regime (e.g., 1st 25%). This will be better explained to avoid this misunderstanding.

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L106. Also combining with Eqs 2. Or alternatively the authors could consider writing Eqs. (3) with 'AS(Q)' instead of '(nS + mSQ)', because when combining Eqs. 1, 3 and 5 'As' is not considered a linear function of Q, as in Eqs. 2.

Response: Following the reviewer's suggestion we will include the general expression for Cs after Kirchner (2016):

$Cs(t) = As \sin(2 \pi f t - \varphi s) + ks$ Eq.(2rev)

before Eq. (2) in the revised manuscript. Eq. (3) follows from inserting Eq. (2) into Eq. (2rev). In section 3, we will explain better how Eq. (6) was obtained: Eq. (5) was proposed based on the search for an exponential function to describe the data points in Fig. 1. We combined Eq. (5) with Eq. (1), and re-arranged the formula so that only As(Q) remains on the left side of the equation:

$As(Q) = Ap [1-(1-Fo) \exp(-Q(t) Sd)]$ Eq.(6rev)

By inserting Eq. (6rev) into Eq. (2rev), we obtain Eq. (6), which allows for estimating Sd and Fo from Cs.

L117-164. I compliment the authors on this analysis: it is very interesting to see what happens when highest flows are excluded in sampling and this helps in the comparison with the results of von Freyberg et al 2018. Looking at Figure 3 I wonder if the same results would be found if the lowest flows were excluded, e.g. <0.5 mm/d? It looks like a much better linear fit would then be reached, similar to the fits of von Freyberg et al 2018. Additionally, I am curious if their catchments have higher base flows or that the lowest flows were not sampled.

Response: At Can Vila, excluding the lowest flows does not change the results in Figure 2, unless DS(logQ) is used. 0.5 mm/day are exceeded only 32.4% of the time (see red line in Figure (5)), so cannot be considered low flows there. Low flows were also sampled at the Swiss catchments, although they were much higher (see also Figure (5)).

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Kirchner, J. W.: Aggregation in environmental systems – Part 1: Seasonal tracer cycles quantify young water fractions, but not mean transit times, in spatially heterogeneous catchments, Hydrol. Earth Syst. Sci., 20, 279–297, https://doi.org/10.5194/hess-20-279-2016, 2016.

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