Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
https://doi.org/10.5194/hess-2021-89-RC1, 2021
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Comment on hess-2021-89

Anonymous Referee #1

Referee comment on "Low hydrological connectivity after summer drought inhibits DOC export in a forested headwater catchment" by Katharina Blaurock et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-89-RC1, 2021

General comments

This study assesses the controls on the export of dissolved organic carbon (DOC) using high frequency discharge and DOC times series datasets across nested watersheds with contrasting topography. Specifically, the authors focus on event-scale export patterns across four events with generally similar event size, but contrasting antecedent hydrologic conditions.

While the results contribute to our general understanding of DOC export behavior and possible controls, this manuscript can benefit from major revisions that focus on a few areas: (1) clarity – the data in this manuscript is extensive, which while useful, makes it very difficult to follow the Results and Discussion sections. The manuscript would benefit from re-writing certain sections of the manuscript to make the event descriptions and comparisons more clear – see specific comments below for more details. (2) The role of seasonality. While one of the major findings is that events in May and September behaved differently, even though event size was similar. However, the authors do not discuss the role of seasonality in their hierarchy of controlling factors. This seems to miss an important biological control on DOC availability.

There are a range of other specific comments outlined below. Once the authors address these major revisions, I believe the manuscript may be suitable for publication in HESS.

Specific comments

L65- 67 – In addition to event-scale dynamics not being linear or having hysteretic loops, they also often do not mirror annual scale dynamics. Here is a recently published paper

that discuss differences in event-scale vs annual scale c-Q relationships that may be relevant for this study:

Fazekas, H. M., Wymore, A. S., & McDowell, W. H. (2020). Dissolved organic carbon and nitrate concentrationâ□□discharge behavior across scales: Land use, excursions, and misclassification. *Water Resources Research*, *56*, e2019WR027028. https://doi.org/10.1029/2019WR027028

Introduction – the knowledge gap for this study is not well explained. The authors state in L 87-89 the main goal of the study, but don't give necessary motivation leading up to this as to why this is needed. The paragraphs leading up to this are largely explaining what our community knows about about DOC-Q relationships, but don't address the gaps.

Description of events – While four events is not that many, it is difficult to keep track of which event is which and how the responses across the watersheds vary. I strongly recommend the authors think about a way to describe these events besides using their dates. For example, could the authors order them by driest (antecedent-wise) to wettest?

Figure 1 – How were the blue streams in this map determined?

L 164-165 – To understand the antecedent hydrologic conditions of the four events, it would be helpful if the authors provide antecedent groundwater levels, or the cumulative precipitation from the water year, or some additional information to help the reader understand the context of the event within range of hydrologic conditions that occur in this watershed. Otherwise, there is no clear rationale for why these four events were chosen to represent c-Q dynamics at this site.

Section 3.3 – This section is extremely hard to follow as written. It is different to understand the differences between all the events at the two different locations. I recommend the authors re-write this section to more clearly introduce the event characteristics.

Figure 4 – Have the authors considered calculating runoff ratios? These are good indicators of how much precipitation translates to discharge each event and can help explain c-Q patterns. Further, are the linear regressions necessary? There are so few points, what do the regressions add?

Figure 5 – What are the time units on precipitation? Is this precipitation per 15 minutes? Further, it would be helpful for comparison between watersheds, since the watershed sizes are different, to have the discharge area normalized for these analyses.

Figure 5 – continued – it is difficult to see the event dynamics in each sub-plot. The authors should consider shortening the x-axis time interval that is displayed to allow readers an opportunity to really see the event specific dynamics.

Figure 6- Could the authors include an identifier of the antecedent conditions or total P associated with each event? This could go in the upper right corner of each subplot.

Figure 6 continued – While the caption describes what the color gradient refers to, it would be helpful if the authors include a legend/scale bar. Therefore, the reader would know what color is related to the peak of the event, for example. Otherwise the color gradient only helps identify the start and end of the event.

L 285 – Can the authors provide more detail about how this 0.32 is calculated? Is this dividing the watershed area between the two watersheds? I do not believe this is described in the Methods section, and for clarity I recommend including this analysis explanation in the Methods section.

L 305-307 – The authors should back up this statement regarding the relationship between watershed area and event response with literature that has shown this pattern as well. For example, are there studies that have looked at transit time distributions as a function of watershed area? This may help support your argument that water must travel further, and thus takes longer, to reach the watershed outlet.

L 309-311 – The transmissivity feedback concept is relevant in all soils, thus it is unclear why the authors invoke this as a particularly important process in the lower watershed.

L 318-320 – Recent work by Michael Rinderer exploring the role of topography on groundwater levels in geographically proximal locations to this study may provide some support for the mechanisms discussed in this section.

Section 4.1 – Is it possible that there is more groundwater recharge in the lower catchment; that is, as water is transported from a topographic steep landscape to a low gradient landscape, could there be water lost to recharge groundwater at that transition? This could explain why the upper catchment is contributing more flow and DOC relative to the downstream catchment. Alternatively, is it possible that the upper catchment is dominated by shallow stormflow contributions, while the lower catchment is dominated by slower moving deeper groundwater contributions? I believe both of these mechanisms are suggested in the Zimmer and McGlynn (2018) paper cited in this section.

L 400-404 – There is no mention of the timing of events within this hierarchy of controlling factors. Certainly conditions in biological activity, temperature, etc that vary by season play an important role in DOC export. The authors even discuss this in the previous paragraph. However, it is not mentioned in this concluding paragraph, which seems to therefore miss a critical controlling factor.

Technical comments

L 3627 – Is Drake et al 2018 related to the previous sentence? If so, I would recommend moving the citation up a sentence.

L 55-56 – Put "e.g. precipitation" in parentheses.

L 196 – should "(1990 and 2010)" be "(1990-2010)"?

L 197 – should "compared to 1600 mm" be "compared to long-term average of 1600 mm"?

L 315 – Missing Figure reference