

## **Point-by-point reply to comments on HESS manuscript HESS-2024-250.R1**

### *“Hydrological Controls on Temporal Contributions of Three Nested Forested Subcatchments to DOC Export”*

*By Blaurock, Beudert and Hopp*

*Dear Editor,*

*Below, you find our point-by-point reply to the remaining comments by the reviewers. We thank you and the reviewers once again for the overall positive assessment of our study and the very constructive review comments.*

*With kind regards,*

*Luisa Hopp (corresponding author) on behalf of all authors involved*

### **Authors' response to Comments of Reviewer 2**

Referee #2:

In their revised manuscript, Blaurock et al. have incorporated my comments to my full satisfaction or explained comprehensibly why they prefer not to do so. I have only one minor remark left, which you can find below. With this remark being addressed, I am convinced that this manuscript will be a very valuable contribution for the readers of HESS.

L 145-147: I missed this in the first round, but could you please explain how you identified snowmelt periods? Via temperature? Could you please add this to your method section?

*We explain how we defined snowmelt periods in L 152 – 154: “Snowmelt was defined as the period when temperatures rose above zero, a snow cover was present, and snowmelt was clearly visible in discharge data at HS as diurnal fluctuations. The snowmelt period ended when the catchments were completely free of snow at all elevations.”*

### **Authors' response to Comments of Reviewer 1**

Referee #1:

Blaurock et al. submitted a revised version of their manuscript, along with their replies to the reviewer comments. I have carefully reviewed both the replies and the revised manuscript, and I thank the authors for their engagement and for making the pertinent changes to the manuscript. I am generally satisfied with the revisions made, though not entirely. I believe this version of the manuscript is close to acceptance; however, some minor (yet important) improvements remain to be addressed, as outlined below.

Remaining comments

L. 14-15. I am not satisfied with the rephrasing of this sentence. “[...] due to the interplay between runoff generated and DOC available for mobilization” is vague/ambiguous. Perhaps “[...] due to relatively lower DOC available for mobilization and runoff generation”.

*We changed the sentence to: “...DOC export was low due to either low runoff generated and/or relatively lower DOC available for mobilization.”*

L. 69-70. I did not mention it before, but this sentence misses a mention to the study site, e.g. “In an earlier study in a temperate forest headwater catchment”.

*We inserted the addition as suggested.*

L. 92. “Hinterer Schachtenbach catchment” not needed as it has already been defined, just say “HStot”.

*Accepted.*

L. 182. Thank you for adding this information but maybe instead write “[...] in similar forested headwater streams”, or “[...] in other cold-climate forested headwater streams”, otherwise the sentence is too strong (and likely untrue).

*We inserted “similar”.*

L. 189-190. Grammatically odd. Please, remove “and” and “were observed” from this sentence.

*We rephrased the sentence.*

L. 228-229. And during most of the winter.

*We rephrased this sentence.*

L. 314. I would say “DOC produced during summer and autumn [...]”.

L. 326-328. I am still not convinced by this reasoning. First, soils might have been wet, but I can hardly believe that they were saturated. You do not provide observations supporting this so you also need to be careful about wordings such as “soils were” and instead using wordings such as “soils likely were”. This “wetness” state might facilitate hydrological connectivity, but only during rainfall events that could activate DOC source areas. The way you formulate the sentence it implies that hydrological connectivity between DOC sources and stream were constant during the spring period, which I don’t think is the case.

*We rephrased the sentence as follows: “Soils were likely saturated after the snowmelt period and, therefore, hydrological connectivity between the DOC sources and the stream facilitated the connection of distal DOC sources (Croghan et al., 2023). This connection contributed to an increased DOC export (Fig. 4) during the spring events.”*

L. 352. Vague. Please, be more specific.

*The section the referee refers to is the conclusion of the first chapter of the discussion, summarizing in general statements our specific observations and interpretations above.*

L. 373-374. This might be a factor, but if true it would not imply that MG is more efficiently at generating runoff, only that you have not accounted for all the water inputs in this catchment. Please, make this point explicit.

*In this section, we are developing some possible reasons for the disproportionately higher runoff generation in the subcatchment MG, as compared to the neighboring*

*subcatchment KS. We are not stating anywhere in the text that MG is more efficient in runoff production. We would prefer to keep this section as it is.*

L. 393-418. As I mentioned before, I was puzzled as to why HSsub (i) was so inefficient at generating stream runoff, especially during autumn (the runoff ratio of 0.13 is strikingly low), and (ii) could still provide water with high DOC concentration so that flow-weighted exports are high across all conditions. You made revisions in this part of the text to address my concern and the explanations are closer to what I would consider satisfactory, but further clarifications are needed. You propose the ponds present at HSsub as the potential source of large DOC influx to the stream from this subcatchment. And you describe that they “fill regularly with water from the bottom during large events and periods of high catchment wetness”. Yet, at the same time you argue that summer and also autumn are periods where soils dry out and hydrologic connectivity is “lost”. **So how can ponds be effective sources of DOC to the stream during autumn if the conditions for its hydrological connection to the stream are not met?** I see some contradictions in the reasoning. Perhaps there is a different way in which these ponds can be hydrologically connected, e.g. via “overland” flow during rainfall events even during low wetness? Or is it that the rainfall events during autumn can quickly connect upper DOC-rich riparian layers even in a context of low wetness and low overall hydrological connectivity? (some kind of “ephemeral” establishment of hydrological connectivity with DOC sources?). Please, give further thoughts to the processes that can explain the observations and produce a more coherent narrative about this particular point.

*In our opinion, we discuss most of the points the referee mentions already in this section. The ponds in the riparian zone can be sources of DOC also during autumn because our observations and measurements have shown how they rapidly fill and empty again during and following late summer/early autumn rainfall events. We describe this in L 408-420, based on data that we presented in an earlier article. Based on the suggestions of the referee, we made some additions to the text that hopefully make our reasoning even clearer.*