

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
<https://doi.org/10.5194/hess-2021-82-RC1>, 2021
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Review of “Patterns and dynamics of dissolved organic carbon exports from a riparian zone of a temperate, forested catchment” by Werner et al. in HESSD

Anonymous Referee #1

Referee comment on "Small-scale topography explains patterns and dynamics of dissolved organic carbon exports from the riparian zone of a temperate, forested catchment" by Benedikt J. Werner et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-82-RC1>, 2021

This study is an impressive assemblage of field, laboratory and modelling techniques to determine the spatio-temporal variability in DOC export (concentration and molecular composition) in a riparian zone. The abundance of different techniques make the manuscript quite dense and it is sometimes difficult to follow the details of the Material and methods, but I would not recommend providing more technicalities (see some exceptions in the detailed suggestions below).

My main suggestion to improve the paper is to rework the introduction and the discussion to 1) identify a clear research question or hypothesis, the introduction is lacking a “problem to solve”. It was not clear to me why such a detailed study would improve management, because the resolution is far higher than any management action, or large scale modelling; 2) develop a discussion that put the results into perspective, while the current discussion is still very similar to the result section and does not contain implications for future research or management.

I also found that the authors made too little use of the different sampling dates, especially those during storm events. I did not understand why several analyses in the manuscript only consider April and December dates, while many other dates are available (I may have missed something here...). Similarly, a high-temporal resolution sampling was performed during selected storm event but the infra-storm events dynamics is not described.

Some work would be necessary to improve the clarity of the text: shorter sentence, less and better use of conjunctions, correct some poor phrasing. I have identified a few examples of sentences to improve but note that English is not my native language either.

Detailed comments:

Title : "from a riparian zone of a" -> "from the riparian zone of a"?

L12 "but poorly understood component": what specifically is not understood. Identify a "problem to solve", a research question or hypothesis in the abstract.

L15 "high spatio temporal resolution": what is the resolution of the DEM?

L15 "Stream water DOC samples from differing hydrological situations": describe these situations, number of sampling dates, study period, etc in the abstract.

L18 "were then simulated": avoid passive voice throughout the manuscript

L20 "two distinct DOC pools (DOCI and DOCII)": describe what make them different in the abstract

L22 "high-resolution topographical wetness index (TWIHR)": specify resolution in abstract.

L27 "should be considered in DOC export models": any implications for management?
Should large-scale models really consider this fine-resolution heterogeneity?

L33 "But despite": don't start a sentence with "but"

L36 "but could" second but in this long sentence

L41 "Especially riparian zones (RZs) of lower order streams are potential targets for..."
poor phrasing

L46 "Here, DOC ..." add reference

L49 "This leads to a stronger accumulation of DOC close to the soil surface..." I did not understand the link with the previous sentence

L52 "led to concepts like variable source zone activation (Dick et al., 2015; Werner et al., 2019), the dominant source layer (Ledesma et al., 2015) and transmissivity feedback (Bishop et al., 2004)" explain these concepts and their limits. Listing them is not enough in an introduction

L55 "a strong focus on vertical heterogeneity" I my understanding the variable source area concept is more about horizontal heterogeneity.

L57 "Moreover RZs are highly dynamic and heterogeneous with micro-topography" the role of micro topography is central to the hypothesis of this work and should be better highlighted.

L65 "Model conceptualizations that are able to bridge those scales" with this sentence it seems that the paper will deal with this question of scales, but it is not the case.

L80 "We argue that a smaller-scale, dynamic assessment of the TWI..." should be the hypothesis of the paper. Please give a response to his hypothesis/question in the discussion/conclusion.

L97 "In this paper we..." intro long enough, no need for a summary of the methods here. Develop problem to solve instead.

L100 "More specifically, (1)..." it would be better to list specific research questions than summary of the methods.

L128 "Electric resistivity tomography (Resecs DC resistivity meter system, Kiel, Germany) was applied at two transects" show the transects in figure 1?

L134 "Two PCM4 portable flow meters (Nivus, Germany) measured discharge in the Rappbode stream at a chosen inlet..." show inlet and outlet in figure 1?

L151 "To have maximum ability in capturing the magnitude and direction of this slope..." poor phrasing

L156 "In addition 3 more wells were installed at 0.3 m depth inside the rectangular grid for surface near sampling." I did not understand this sentence.

2.2.3. I found it difficult understand the maximum depth and the screening height of the different piezometers and wells. Please rework this section to improve clarity.

L166 "Biweekly routine samples..." it is never clear whether biweekly means twice a week or every second week. Please use a less ambiguous term. Please also add the number of sampling dates and the number of dates when FT-ICR mass spectrometry was used. Is it only two dates?

L181 "samples were filtered using 0.45 μm membrane filters" did you filter the samples in the field or back in the lab?

L280 "2.4.3 Calibration" is it possible to provide the objective function of the calibration? I understood that the model aimed to simulate both the stream discharge and groundwater depth in several wells, with a weighting scheme giving a high importance to the groundwater, but it would be interesting to see the equation of this objective function.

L322 "The DInf algorithm was used" please explain what it is.

L335 "Discharge shows event-type, erratic variability" poor phrasing

L360 "DOC in riparian water samples was in general of highly unsaturated and phenolic composition, typically found in lignin and biomass type compounds" can we see this in a table or a figure?

L395 "Note that wells, sampled during different occasions throughout the year occur in both DOC clusters and according TWIHR values can thus occur in both clusters" it is unclear to me to what extent a given piezometer belonged to the same cluster throughout time. This sentence suggests that the cluster can change, but a quantitative assessment of how many piezometer remain in the same cluster or change clusters would be interesting here.

L415 "The significant difference in TWIHR median values of DOCI and DOCII wells" I did not understand how you could classify wells as DOCI-well or DOCII-well if a given well

could change clusters in different dates.

L416 "using the median TWIHR value of the DOCI group (9.66) as a threshold." I did not understand this choice; please explain the rationale behind this.

L418 "Also note that different samples of one well can appear in both DOC groups" please give numbers.

L435 "Fig. S7, Table S4 for according water fluxes" -> "corresponding water fluxes"?

L454 "During the model period, DOCI source wells had a median DOC concentration of 5.8 mg L⁻¹ which was 2.3 times higher than for the DOCII source wells" it would be interesting to remind the mean \pm sd of the two types of wells. Do deeper wells match with the DOCI cluster?

L487 "as typically found in deeper soil layers" what influences the difference between DOC I and DOC II more: the TWI or the sampling depth? (or both are related?).

L491 "indicating a replete DOC pool with constant contribution to the overall DOC quality in the stream" unclear sentence

L493 "indicating the influence of seasonality on this pool." It is difficult to make such a conclusion with only two dates.

General comment on "4 Discussion": this discussion is too similar to the result section, many conclusions are specific to the study site while readers would expect to see the results put into perspective, with more implications for management and research, more key messages and more references to the literature.