

Hydrol. Earth Syst. Sci. Discuss., referee comment RC2
<https://doi.org/10.5194/hess-2021-358-RC2>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on hess-2021-358

Anonymous Referee #2

Referee comment on "Groundwater flow paths drive longitudinal patterns of stream dissolved organic carbon (DOC) concentrations in boreal landscapes" by Anna Lupon et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-358-RC2>, 2022

This is a potentially interesting paper but one that needs some attention before publication. There are several aspects of the paper that rely on results from previous papers. Some, particularly the locations of DRIPs, need more explanation here. Other aspects (such as the discussion of uncertainties) also need more detail.

I also do not get a clear sense of how this paper helps address important problems or knowledge gaps. A clearer explanation in the Introduction of where those gaps are and the Conclusion of the broader aspects would help here. It is an important topic, but the importance needs to be better explored.

The paper is generally clear but has minor grammatical errors throughout and occasional odd phrasing. I have sympathy with having to write in a second language, but checking the English would help communicate the research better.

I hope that these comments are useful.

Title.

Not sure that this reflects the paper's contents well. There is no explanation of parsimony in the paper (ie what are the alternative 'non-parsimonious' approaches?) If parsimony is important it needs to be reflected in the Introduction and Discussion.

Abstract

The Abstract is a reasonable summary of the paper, but there is a lot of focus on what was done rather than what was concluded. Also as with the rest of the paper try to add some indication of importance in the statements at the start and the concluding statements at the end of the abstract.

Introduction

The introduction is reasonably comprehensive but suffers from some odd terminology. More importantly, it does not convey a sense that the paper is addressing an important general question. What is it that we really don't know that this paper will help understand? DOC (and C in general) in rivers is important but there have been many studies over recent years. If you explain what the key gaps in our understanding are and how this study helps address those, then the paper will have more impact with the scientific community. Your aims should also refer back to those broader themes.

L35. "Running waters" is odd terminology if you specifically mean rivers.

L39-43. Point not clearly made. There are obviously differences in sources of water, retention times, and flowpaths in headland streams but HOW do those result in differences in DOC? Terms such as 'dynamics' are a bit vague, better to explain exactly what you mean (sources, loads, reactions etc).

L52. What is a 'spiralling framework'?

L61-66. Is this universally true? Reactions in groundwater likely reduce DOC loads and, in many catchments, the deeper groundwater seems to have lower DOC concentrations than surface runoff. In which case groundwater inflow may dilute surface water DOC concentrations. Perhaps be more circumspect here?

L81-90. Your aims are fine as far as they go, but I don't get a good idea of how these fit

in to a broader understanding of the science.

L89. Not sure the 'passive pipe' argument is valid. It is generally accepted that streams are dynamic environments, particularly around reactions involving compounds such as DOC. This makes it seem that you are addressing a problem that may not exist.

Methods

Section 2.1

Given the importance of understanding the groundwater inflows to the stream and the origins of the groundwater, more details are needed here. It seems that some of these are in other papers but better explanation would make this paper more convincing. Specifically:

- L112-114. It is not clear what you mean by "route 60% of the upslope contributing areas to 5% of the stream length". I presume that your DRIPs occur along 5% of the stream but where does the 60% area come from. This is probably in the Leach et al. paper but more details are needed here
- What exactly is the groundwater? Are you sampling only shallow riparian zone waters or a mix of those and deeper groundwater? Explain how deep the bores are and what units they are screened in.
- How are the DRIPs identified and do you have diffuse discharge between the DRIPs?
- Some descriptions (eg shallow and near-surface) could be more specific (ie are the groundwater levels above the land surface?)

L98. What underlies the regolith and soils? Are there deeper aquifers that can contribute groundwater and if so do we know anything about that groundwater?

L100-110. This description is difficult to envisage. You should illustrate the variations in river flow and groundwater responses on a Figure. Most of those details are in Fig. S1. Given that you have only 3 figures in the paper (and only 1 is multipart) you could easily fit Fig. S1 into the main text (and also Fig. S2 if you wanted) – figures in supplements rarely get looked at.

Figure 1. What are the contours (I presume elevation)? Given the topic of the paper, can you show groundwater flow paths – you refer to these in the caption (L120) so presumably you know something about them.

Section 2.2

L123-127. That is not really a drought. Droughts imply that the catchment as a whole dries up, which impacts more than just river flows (groundwater levels, soil moisture are also impacted). While, this analysis is useful, 'artificial low flows' or something similar would be better.

L132-135. Not clear how the DRIPs were identified from the wells (which is what you imply). Or do you mean that you located the wells following identification of DRIPs? Again, I think that these details are in other papers but would be better summarised in section 2.1.

L136. "thalweg"

L137. "evacuated" not "vacuumed".

L146. Report the typical or range of analytical uncertainties here.

Section 2.3

L165-169. As noted above, the classification of reaches and location of DRIPs needs more justification. It is important to the study. It seems that much of this comes from the geometry of the catchment, specifically the UCA., with the details only in other papers. It may be correct, but as presented here it is not very convincing.

L176-177. The interpretation that all increase in streamflow is due to groundwater inflows is also important and needs more detail. From Figure 1 there looks not to be any significant tributaries, but what about overland flow, small rivulets, draining pools etc (especially at high flows). You should be more specific in ruling those out if they do not exist.

L198. see comment earlier about 'passive pipe' and perhaps come up with a better term.

L199-201. Not very clear what you mean by 'upstream', do you mean above the lake?

L232-255 Do you present the uncertainties in the paper (it is not clear that you do)? There should be more discussion in the results or discussion sections.

L234-239. Is there any reason for only using 100 model runs? I would have thought that the model is not computationally limited and more runs would be possible. If increasing the number of runs resulted in the same rand and distribution of outcomes than you should state that. I agree that studies should not do redundant analyses, but knowing where redundancy occurs is useful.

Results

L259-265. This is really a summary of the results and would make more sense after you have described the data from the different studies. Suggest moving to the end of this section or to the beginning of the Discussion.

L283. See comments earlier about calling this a 'drought'

Table 2. Difficult to read (final version needs line breaks fixing)

Sections 3.1 to 3.3. These are detailed but a bit dense to read. The level of detail also tails off a bit. In 3.1, you report the DOC concentrations but not in the other sections. Given the level of detail here, it is difficult to have to keep looking at Figure 3 to see the changes. Adding the values in here would help.

Discussion

Here I think that a better discussion of the uncertainties (which are the most important, does that differ between the different conditions is needed). All I understand to this point is that the uncertainties were used to generate the predictions in Figure 3, but not what the main uncertainties are.

L325-329. Using the model names introduced above would help to key this discussion into the previous sections and Figure 3.

L347-349. Do you mean that DIFF BIO is the better model (not UCA BIO)? The NSE and R2 in the table would indicate that was the case.

L355. 'drought' and 'pipe' comments again.

L361-368. This is written as if the catchment is really considered to have been in drought (rather than just the flows being artificially low). Are these findings what you would expect if the catchment was relatively wet and just the flows were impacted?

Conclusions

As with the Introduction, there is no broad overview here. As it is the Conclusions are understated. A final paragraph or two explaining the broader relevance of this study or outlining what you think you have done which is novel is needed. Be more specific how you contribute to the "greater goal" of understanding these processes. That would make the study more interesting and impactful to a wider audience. Perhaps speculation on what this means for DOC if flow regimes change would be interesting and useful here.

