

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1  
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## **Comment on hess-2022-149**

Anonymous Referee #1

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Referee comment on "Exploring tracer information in a small stream to improve parameter identifiability and enhance the process interpretation in transient storage models" by Enrico Bonanno et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2022-149-RC1>, 2022

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This paper has promise for benefitting the hydrologic community in regards to understanding parameterization of transport metrics via modeling, however, I recommend the authors make some substantial revisions to broaden the audience and better clarify the significance of their results. The following are suggestions/ comments I have that I believe would improve this paper and its impact.

The effort put into answering and addressing questions 2 and 3 are not to the same rigor as question 1. Methods, results, and discussion for question 1 is clear, but not for questions 2 and 3.

The paper is jargon heavy and not readable to a wide audience. Certain vocabulary is not defined or explained well, such as global identifiability vs dynamic identifiability. Additionally, many sentences and paragraphs are not fluent and have poor sentence structure, especially throughout the introduction. Some specific comments are highlighted below.

The introduction addresses certain open questions / problems but then lists specific questions being answered. It's then confusing as to what questions will and will not be addressed in this paper. I think it would benefit readers to remove the earlier questions mentioned and stick with the ones at the end of the introduction.

For the methods section, there is no explanation of how question 2 was answered. What specific sections of the BTC did you investigate and how did you break the BTC up into different sections? Also, why are the tracer experiments all done during the same season? I acknowledge that the discharge is still varied, but are there other hydrologic processes that change throughout the year not captured by winter tracer studies? I believe a simple

reactive transport study using the different parameter estimates would enhance this study and better highlight the impact and importance of the uncertainty in parameter estimation.

There is little explanation on whether or not their results make sense in the context of physical hydrologic processes and past studies (ie. Does it make sense that a variable velocity that is not determined a priori make sense?). Further, the discussion is sometimes a repeat of results rather than a discussion of the implications of the results. Why do the results matter? How does that align with our current understanding?

Also, the paper is not well organized. The intro clearly outlines 3 questions to be addressed. It would make sense to me, if the methods, results, and discussion followed that order. Instead, section 4.1 addresses section 3.2 which addresses question 1. Section 4.3 addresses question 2, but question 2 does not have a methods or results section.

Finally, the discussion and conclusion are missing an explanation of how to go forward from these findings. Line 535 states that process interpretation and parameter evaluation should be used with caution, but how do we address that? What are the next steps?

The study is novel and can be beneficial for those studying hydrologic exchange in river networks and using tracer experiments, but this paper would greatly benefit from some restructuring and re-writing for improved readability and explanation of methods and results.

Specific things to address are listed below:

First paragraph of intro is confusing. You mention modeling, then experiments, then talk about issues with modeling again. I think it's worth re-organizing in the following way:

- Understanding transport along river networks is important
- One way is with experiments
- However, current models to describe the processes seen from experiments have contradictory results
- So, it is unknown how informative modeling is

Lines 67-73 is jargon heavy and phrasing is clunky

Sentence 103-104, repetitive

The whole paragraph starting at 113 is confusing.

Also unclear on if the results make sense in terms of physical processes and our current understanding or if they're spurious relationships (ie non-id A\_TS coupled with ID alpha, and when  $v=v_{peak}$  the reverse of that)

Should review and cite Rathore et al., 2021, "On the Reliability of Parameter Inferences in a Multiscale Model for Transport in Stream Corridors". I believe this paper aligns with your study and might provide some further insight.

No explanation on global identifiability vs dynamic identifiability

Should reread Gooseff et al., 2005 and update the sentence starting at line 475 as the statement is incorrect as it stands.

Figure 8, what is DYNIA analysis? This is not previously explained.