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Comment on hess-2021-355

Anonymous Referee #2

Referee comment on "Tandem use of transit time distribution and fraction of young water reveals the dynamic flow paths supporting streamflow at a mountain headwater catchment" by Ravindra Dwivedi et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-355-RC2>, 2021

The work of Dwivedi et al. studies travel times in the Marshall Gulch research catchment, Arizona, for a better understanding of flow paths and storage in a mountain catchment. This is done through a strong data set of stable isotopes and tritium. The paper is mostly well written. I like and appreciate the combination of tritium and stable isotopes, I believe that this is an important endeavor. However, the current manuscript has a range of serious limitations.

First, the introduction reads like a patchwork of ideas and concepts but stays vague and thus not convincingly outline a limitation/research gap. Thus, the research question came somewhat out of the blue for me. I was not able to find any information if the research on these objectives is needed or not. After reading the full manuscript, I felt that this even more important as the work read like a compilation of applying methods without a clear strategy concluding that there are different results depending on tracer and methods.

Second, the methods are an issue. It is unclear why the methods are chosen. It feels like an application of a range of methods and see what comes out. I cannot find a clear strategy behind. Even more critical, by applying time invariant approaches for travel time distributions, the paper methodology is lacking a decade behind recent developments in the field (see the wide range of work, even cited, on time variant TTD and SAS functions). The young water fraction is state of the art though, but here the work again suffers from the lack of clear strategy. In addition, stable isotopes and tritium tracers should ideally be used in a joint calibration to obtain a travel time consistent for the tritium and stable isotope observations (cf. Rodriguez et al., 2021). You might even be able to calibrate the multimodal age distributions of your travel time doing so – however, this is just speculation. Yet, this could be a really nice contribution to the field of TTDs.

Overall, I think that the manuscript would need a very major rework to be publishable. This would include a full adaptation of the methods to the state of the art. I have doubt that this can be done within a major revision.