Hydrology and Earth System Sciences Discussions

Interactive comment on "What can flux tracking teach us about water age distributions and their temporal dynamics?" *by* M. Hrachowitz et al.

M. Hrachowitz et al.

m.hrachowitz@tudelft.nl

General Comments

Comment: The manuscript deals with the analysis of tracer data to derive information about different age distributions related to catchment hydrological processes. It gives an excellent review not only about former and current research on flow path distributions, but also on different mixing model concepts including complete, static and dynamic partial mixing. Both parts are very helpful, especially to a reader that is not 100% familiar with the general topic presented. In the following the authors analyse 3 hydrological different catchments in Scotland, using 2 different mixing models and considering three different age distributions.

Reply: We would like to thank the reviewer very much for his or her positive evaluation of our manuscript

Comment: While this makes absolute sense in principle, the consequence is a very extended section 4 that has been difficult to read and to follow. I would prefer seeing that paper to be split up into at least 2 papers, however I cannot make a good suggestion where to cut and would therefore also accept this long version.

Reply: We agree with the reviewer that this is a long manuscript and we initially shared the same concerns. However, after lengthy discussions with many colleagues from the catchment hydrology community and careful deliberation we came to the conclusion that the presented information can only be fully appreciated if it is shown in the full context. This is especially important as much of the literature on water age is quite scattered, which also contributed to the fact that some important aspects of the topic (as highlighted in the manuscript) were simply forgotten or, when seen out of context, not considered relevant by wide parts of the community over the past 3 decades or so. As the presented information further does not offer a clear splitting point for providing 2 papers (i.e. which part would go into which paper?) as the information is very interwoven, we would thus strongly prefer to present the information in one single manuscript instead of splitting it up into 2 papers.

Comment: A general question that occurred to me was the following: Authors state that they have applied an extensive Monte Carlo –type optimization approach using 5 measures of goodness of fit in order to come up with one suitable/feasible model version. To what extent would different (but almost equally good) (hydrological) model structures and parameters have an impact on the derived age distributions. This would be interesting to see in comparison to the variations produced "simply" by different mixing model, and would possibly strengthen the robustness of conclusions drawn. I know this step would even extend the paper, but might be an interesting topic for a split up version or future extensions

Reply: We agree with the reviewer that this is a very interesting question and it was recently partly addressed in a paper by McMillan et al. (2012). But we also agree with the reviewer that an inclusion of that aspect would go beyond the scope of the paper. We would however like to mention that a manuscript addressing in detail the reviewer's suggestions is presently in preparation.

Minor Comments

Comment: p.11372, l1: should be : : :.DYNAMIT (DYNAmic MIxing Tank)

Reply: Ok

Comment: p.11372, l24: what is this cursive i for

Reply: The reviewer is right, the first i is redundant and will thus be removed. The second i is the variable for the number of the respective elevation zone for which snow melt is computed.

Comment: p.11378, l12: I would argue that while wetting up the matric potential(!) is increasing (from very negative to less negative values)

Reply: Ok

Comment: p.11379, l14-16: I am not sure what this sentence in that context means

Reply: This sentence was merely meant to avoid misunderstandings and to make clear that we are aware of the presence of more physically based and more detailed mixing representations, which however are not warranted here by the available data. As also reviewer 1 found this sentence confusing we will remove it.

Comment: p11387, l21: Where is the third model (Dynamic Partial Mixing)? If not used, why is it introduced?

Reply: We thank the reviewer for pointing this out. Here "two mixing model hypotheses" should actually read "two mixing model scenarios". As outlined on p.11379, l.3-9 of the

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original manuscript, two SCENARIOS were tested: the first one with complete mixing in all model components and the second one with complete mixing in the interception and fast reservoirs, static partial mixing in the slow reservoir and dynamic partial mixing in the unsaturated reservoir. We will rephrase it to "scenario" and emphasize this stronger to avoid future misunderstandings.

Comment: p11394, l14: What is a median distributions? This is also not explained in the Figure caption.

Reply: The reviewer is right that we did not properly explain what is shown in Figure 6. In fact it is the temporally averaged, unweighted distribution constructed from the respective median values for every transit time during the four individual wetness conditions (dry, wetting-up, wet, drying-up). This will be better explained in the revised manuscript.

Comment: So, in summary I would like to suggest the acceptance of the manuscript with only minor corrections as outlined above.

Reply: We sincerely appreciate the reviewer's positive evaluation and would like to thank him or her.