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Discussions

Interactive comment on "Lumped convolution integral models revisited: on the meaningfulness of inter catchment comparisons" *by* S. Seeger and M. Weiler

Anonymous Referee #3

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General Comments:

This paper looks at transfer functions that describe hydrologic catchment response and water transport in catchments for the use with lumped convolution models. The authors use data from 24 Swiss catchments to see whether they can find transfer function types that work better than others at specific locations. They also check whether physical catchment parameters can be correlated with the mean of the transfer functions (mean transit times).

The topic is interesting and timely. And while the use of time-invariant transfer functions

can now almost be called old-fashioned, the large data set that allows for a comparison of that many catchments still promises novel results.

I only have two main concerns reading the paper. First, I wonder whether the structure of the input data influences the results and conclusions. The data is rather sparse temporally as well as spatially and more smoothing is introduced by a novel interpolation method. I could for example imagine that due to the smoothed input, transfer functions that smooth data less than others would in this scenario produce better fits and fewer errors than they would otherwise (if the input was more variable). The authors should discuss this. Second, the authors should also discuss their results on the relations between mean transit times and physical catchment properties with regard to recent work on temporally-varying mean transit times.

The paper is well-written and the structure is clear. I think it can be published pending intermediate revisions that address the issues of smoothed input and time-variable transit time correlations with topographic parameters.

Specific Comments:

p. 6754, l. 2: The TTD is not only linked to water storage potential, so you should maybe add 'amongst other things' to the statement. It is the first sentence of the abstract after all and should therefore be a little more general.

p. 6754, l. 11: Reading the abstract I did not know what you mean by 'normalised'. In the paper it becomes clear, but just reading the abstract alone leaves you wondering.

p. 6754, l. 15: What do you mean by '. . .transfer functions mainly have to agree on an intermediate time scale. . .'?

p. 6755, l. 12: Other important references would be Van der Velde et al. (2010) and Botter et al. (2011).

p. 6756, l. 1-17: There is a relatively new paper by Heidbüchel et al. (2013) that investigates MTTs under different meteorological conditions and assesses how these conditions alter the influence of the physical catchment characteristics on MTTs. You should definitely have a look.

p. 6757, l. 23: .'...differences in discharge behavior among the catchments.' Add something like: '...which we will not describe here in detail.'

p. 6758, l. 22: Deuterium and oxygen-18 do only 'almost' convey the same information (see Lyon et al. (2009)). It is fine, however, that you make this assumption.

p. 6763, l. 5: Does this method also take into account the fact that early melt water is very much enriched in the heavy isotopes?

p. 6774, l. 3: Do you think that the averaging and smoothing of the input that is introduced by this method is one reason that no transfer function type could be singled out as the best one? Maybe if you had better input (i.e. more resolved in time and space) than you would find that for example the gamma function is better able to reproduce the short-term variability.

p. 6777, l. 27 – p. 6778, l. 21: Again, this is where it would be helpful to compare and discuss your results with regard to the results of Heidbüchel et al. (2013). They found that the MTTs of catchments for three different years correlated with different physical catchment properties, depending on the specific weather conditions during that specific year. Not only was it important how much precipitation fell in one year, it was also important whether this precipitation was more distributed over time or whether it was more concentrated in certain periods. They went on to explain this observation by linking weather conditions with storage states and storage states with predominant flow paths. Depending on the specific flow paths MTTs were then controlled by different physical catchment properties. Maybe you can find something similar in your study?

p. 6779, l. 14: What about using the median value instead? Since the long tails are not identifiable with stable isotope data anyways the median would not be affected that dramatically by the shape of the tail.

Figures & Tables:

Figure 6: '...bottom left and ENTIRE right column...'

Figure 8: Why do you write '1/damping ratio' on the y-axis and 'TTP' on the x-axis?

Technical Corrections:

p. 6755, l. 3: I'm not sure whether one can use 'whose' with regard to a tracer?

p. 6757, l. 16: '...catchment precipitation_ rangeS from...' '... and the_ seasonal...'

p. 6760, l. 11: '...average ELEVATION gradients...'.

p. 6768, l. 12: 'Independent_ from...'.

p. 6768, l. 13: '...equally satisfactorILY...'.

p. 6769, l. 9: The Sitter catchment is in the third ROW of figure 5, not in the third column.

p. 6770, l. 12: '...account, _ clear differences...and GM WERE observed...'.

p. 6770, l. 24: Where are these 'blue highlighted lines' in the top right section of Fig. 6?

p. 6771, l. 2: '...result in _ MTTs of...show _ MTTs of...'.

p. 6777, l. 5: '...seems _ suited to...'.

p. 6782, l. 20: '...a reasonably GOOD performance of...'.

References:

Botter, G., E. Bertuzzo, and A. Rinaldo (2011), Catchment residence and travel time distributions: The master equation, Geophys. Res. Lett., 38, L11403, doi:10.1029/2011GL047666.

Heidbüchel, I., P.A. Troch, S.W. Lyon (2013) Separating physical and meteorological controls of variable transit times in zero-order catchments, Water Resources Research, 49, 7644-7657, doi:10.1002/2012WR013149.

Lyon, S.W., S.L.E. Desilets, and P.A. Troch (2009), A tale of two isotopes: Differences in hydrograph separation for a runoff event when using dD vs. d18O, Hydrological Processes, 23(4), 2095-2101, doi:10.1002/hyp.7326.

Van der Velde, Y., G. H. de Rooij, J. C. Rozemeijer, F. C. van Geer, and H. P. Broers (2010) Nitrate response of a lowland catch-ment: on the relation between stream concentration and travel time distribution dynamics, Water Resour. Res., 46, W11534,doi:10.1029/2010WR009105.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 6753, 2014.