Hydrol. Earth Syst. Sci. Discuss., 11, C3285–C3290, 2014
www.hydrol-earth-syst-sci-discuss.net/11/C3285/2014/

Hydrology and Earth System Sciences
Open Access
Discussions

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

S. Seeger and M. Weiler

stefan.seeger@hydrology.uni-freiburg.de

Received and published: 22 August 2014

1 General Comments

[. . .]. 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. [. . .]

Reply
We would like to thank Anonymous Referee #3 for the thoughtful comments. We agree that the stream isotope data time series are rather sparse. The reasons for the sparse input data do mainly originate from financial constraints to the study design. While the precipitation isotope data is spatially sparse and its coarse temporal resolution of monthly bulk samples introduces smoothing, we would like to point out that our interpolation approach does not introduce any further smoothing. With the available data, an analysis of short-term stream discharge behaviour is not possible and the results of this study rather refer to baseflow conditions and we will make sure to clarify this in the revised version o the paper. As our study focused on time invariant transfer functions, we missed to consider studies which focus on temporally-varying mean transit times and their relation to physical catchment properties. We are thankful for the hint and will reconsider the discussion of our results with respect to the mentioned recent studies.

2 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.

Reply
As we rewrite the abstract for the revised version of the paper we will take care to be more general in the beginning.

p. 6754, l. 11: Reading the abstract I did not know what you mean by 'normalised'. In

HESSD
11, C3285–C3290, 2014

the paper it becomes clear, but just reading the abstract alone leaves you wondering.

Reply
As suggested by Anonymous Referee # 2, we will remove the normalised transfer functions altogether. Therefore this will be no issue in the revised abstract.

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

Reply
We admit that the way we included this finding (discussed in Sec. 5.4 of the manuscript) into the abstract, the statement could benefit from a more detailed rephrasing. We will clarify this in the revised version of the abstract.

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.

Reply
We will consider these references in the revised introduction.

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.

Reply
We are aware of the fact that there is a stronger effect of evaporation on O^{18} data than on H^2 data. In case of notable evaporation influences the two would not convey the

HESSD
11, C3285–C3290, 2014

same information. In our case we can rule out a notable alteration by evaporation, as all sampled isotopic compositions of precipitation and discharge plot on the same local meteoric water line.

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?

Reply
This effect is not taken into account, but is discussed in Sec. 5.3. If we considered a small area on a high temporal resolution, this certainly would play an important roll. In our case the fortnightly sampling of discharge isotopes as well as the vertical extent of most of the study catchments probably decreases the measurable influence of this effect sufficiently.

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.

Reply
Our method of precipitation isotope data estimation works with (uninterpolated) deviations from average values. This approach may introduce a bias, but it should not introduce any smoothing compared to the station data. The monthly averaged precipitation isotope data and the fortnightly discharge sampling certainly do introduce a smoothing and temporally higher resolved isotope data would hopefully allow to decide between the TPLR and the gamma function.

p. 6777, l. 27 – p. 6778, l. 21: Again, this is where it would be helpful to compare

HESSD
11, C3285–C3290, 2014

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?

Reply
We will try to consider this when revising the paper.

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.

Reply
In comparison to the MTTs, the consideration of median transit times decreases the absolute range of uncertainty, but it hardly changes the ranking of the catchments. As previous studies focused on MTT comparisons, we would like to adhere to this practice, be it to point out its weakness.

3 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?

HESSD
11, C3285–C3290, 2014

Reply
We will correct these oversights in the revised version of the paper.

4 Technical Corrections

We appreciate the technical corrections and will implement them in the revised paper.

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