

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

Anonymous Referee #1

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General Comments:

The paper applies lumped convolution integral models to stable water isotopes to determine the mean transit times (MTTs) of 24 catchments in Switzerland. The further aim was to assess the MTTs in relation to the topographical indices of the catchments and develop a topography-driven regionalisation method. The paper does a valuable job in revealing difficulties with these objectives, firstly with determining MTTs of streams from stable isotope data, and secondly with deriving relationships between MTTs and catchment characteristics.

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The MTT estimates were derived using three different transfer functions (TFs) to assess the suitability of each for this application. Although the different TFs were able to fit the stream isotopic data almost equally well, they gave very different MTTs. This result followed from the different long-transit-time tails of the transit time distributions (TTDs) given by the different TFs (and to a lesser extent by the different short-transit-time tails). The heavier the long TT tail, the longer the MTT. The authors point out that stable isotope data does not contain enough information to delimit the long TF tails, because stable isotope variations are gradually smoothed out by mixing. Consequently, a longer-term tracer such as tritium is required, and would have greatly assisted this study. On the second objective, although the MTTs showed correlations with topographic indices, the correlations could be mainly ascribed to mean annual precipitations which correlate with both. When this complicating factor was removed by normalisation, the MTT correlations with topographic indices were less apparent.

The paper is well written, has an impressive data set, presents many novel methods and insights, and reaches substantial conclusions. Overall presentation is clear and fluent, with remarkably few technical corrections needed. References are appropriate and the paper well-structured with no unnecessary or overlong sections. The scientific methods and assumptions are well described and appear to be valid (some specific comments are given below). Innovative snow storage and effective rainfall models were applied to determine the amount and isotopic composition of the input to the models. The data set is sufficient to support the discussion and conclusions. Title and abstract are satisfactory. I think the paper should be published after minor revision.

Specific Comments:

1. Steady state lumped parameter models were used to determine MTTs, although it is expected that time-variable parameters should apply especially during short-term high flow episodes. Such an approach (with their two-weekly sampling regimen) means essentially that baseflow transit times were being determined in this study (especially if sampling during high-flow periods was avoided). This may be a satisfactory approach,

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although it is by no means clear that baseflow MTTs will be constant in time (e.g. that high baseflow MTT will equal low baseflow MTT). If baseflow TTDs are time-variable, the long transit time tails will be even more “underdetermined” than indicated in the paper, and the need for a longer-term tracer greater. I think that studies such as this should point out that they are talking about baseflow transit times, not streamflow transit times.

2. The paper uses two variants of the three TFs, normalised and unnormalised versions. I found these difficult to understand, although a description is given in Appendix A. In particular, if it is logical for the TFs to be normalised, then why give both versions? Is there doubt about which version is correct?

3. Table 4 caption contains the sentence “Significant correlations (p value<0.05) are printed in boldface, correlations with p values ≥ 0.2 are printed in italics.” I cannot see how this relates to the boldface and italic numbers in the table.

Technical Corrections:

6758/11. “VSMOV” ... should be “VSMOW”

6758/19. “extent” ... should be “extend”

6761/8. “according” ... suggest “corresponding”

6773/21. “Because the availability ... study catchments” ... change to “Despite the availability of precipitation isotope concentration data being suboptimal (insufficient precipitation isotope data measured within the study catchments”

6778/5. “expose” ... change to “have”

6780/21. “cannot” ... change to “can no”

6781/1. “encountered” ... change to “corrected”

6781/8. “independent from” ... change to “independent of”

6782/20. “well” . . . change to “good”

6802/1,2/Caption. “Exemplary” . . . change to “Examples of”

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