

Interactive comment on “Integrated response and transit time distributions of watersheds by combining hydrograph separation and long-term transit time modeling” by M. C. Roa-García and M. Weiler

Anonymous Referee #1

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Review of “Integrated response and transit time distribution of watersheds by combining hydrograph separation and long-term transit time modeling” by Roa-Garcia and Weiler submitted for publication in Hydrol. Earth Syst. Sci.

The authors present a new modeling approach that integrates the transit time distribution and response time distribution across different time scales. The authors argue that the combined approach provides a more realistic description of water movement through a catchment. The model is applied to three Andean headwater catchments with somewhat different catchment characteristics.

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The paper is nicely written and has great potential but I suggest major revisions before I can recommend it for publication.

General comments

My greatest concern with the paper is the lack of data presented. The authors spend large effort to present how the data has been collected, model description and results. But nowhere is the actual isotopic data found. The lack of data is problematic as I as reader have no possibility to understand how relevant the data is for the task ahead. The use of isotopic data has great potential but unless it shows enough separation between the event and pre-event fraction it cannot be used. I therefore urge the authors to present the basic ^{18}O information from both precipitation and stream water.

I suggest that some of the Fig 2-5 are replaced by showing both the entire time series of precipitation and runoff ^{18}O and some more detailed graphs of the specific events analyzed. I find some of the Fig 2-5 redundant. They look much the same and could therefore be reduced to a minimum.

Also I find both the legend and figure text too minimalistic. The reader should be able to read the figure texts as standalone. As it is now you have to know all abbreviations to understand what the figure is about. And the axis should also be somewhat self-explanatory.

In the use of isotope hydrograph separation (IHS) methods it is important to investigate the result uncertainty. There are several methods to do that (for example the one presented by Genereux, D., Quantifying uncertainty in tracer-based hydrograph separations. *Water Resour. Res.*, 34, 915-919, 1998). As the paper stands now the authors go into great depth to explain variability in the event/pre-event fraction without knowing if the pre-event water component is statistically different between sites.

In the paper a large emphasis is placed on the fact that there is a difference between the three catchments. I think that authors could make a better attempt to justify this

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finding (see also the uncertainty above). Below are a few questions that come to mind.

1. There is a large difference in precipitation amount between the three different catchment despite the fact that they are adjacent (table 2). How does the fact that the precipitation at B1 and B2 are up to 50% higher compared to BB affect the pre-event water fraction calculation? And if the spatial variability between the three adjacent catchments is so large how has this variability in the precipitation been account for. Have any spatial interpolation been done?

2. The authors suggest that the 6% wetlands are the main cause of the large pre-event fraction. If this in fact is true still after all uncertainty been included, how reasonable is this? I would like to see a more thorough discussion to whether this small contributing area can affect the results in such a profound way. Are there no alternative reasons for why BB is responding differently?

One page 8, line 28-30 it is stated that the input data was extended by correlating the observed isotopic data to the nearest climate station. No such data comparison is presented. A comparison of both precipitation amount, timing and isotopic data is absolutely needed.

Stream flow is another important factor that is used in this study. There is no information on what type of constructions that has been used (Natural sections, weirs, flumes). There is also no info on how well the stage/Q relationship worked.

Analytical method: It is not important where the analyses have been conducted but rather what type of instrumentation that was used.

Smaller comments 1. Why aren't the same events used for all three catchments (see table 2). This makes the entire comparison difficult. 2. The headings in table two need better explanation. 3. Table 1. Have you measured catchment size and catchment characteristics to one decimal point of a hectare? If so please provide an explanation of how this was conducted. 4. Fig 1. It would be beneficial if the precipitation stations

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are shown in the figure 5. Check your spelling of Kirchner. Some different ways are used.

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