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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Land use alters dominant water sources and flow paths in tropical montane catchments in East Africa" *by* Suzanne R. Jacobs et al.

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We would like to thank Reviewer #4 for the feedback and will respond to the major comments provided by the reviewer. Other suggestions will be incorporated in the revised version of the manuscript.

1) Given that, the available isotopic data is only 1.5 years long the authors should provide an assessment of the uncertainty in the computed MTT? The performance of the fits by the Gamma and EPM are actually similar yet the MTT for OUT_S15 was different between these two models. How do you explain that? It is not clear how the authors chose the Gamma and EPM functions. Did they consider what model

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had better constrained parameters? In addition to the modelling shortcomings, how can MTT estimates calculated from 1.5 years of data provide information about the hydrologic impacts of different land covers?

Reply: A revised version of the manuscript will include detailed plots of the best solutions and the associated uncertainty ranges, for every stream and soil water site as supplementary information. Indeed, the performance of the fits to the objective function (NSE) for Gamma and EPM are quite similar, however it is not true that the related MTT estimations differ, we acknowledge this in the last paragraph of the Discussion section when referring to soil water sites (P. 14, L. 1–7). In this regard, if we use a parameter of η=1 when using EPM, or α=1 when using GM, then GM or EPM becomes a simpler EM, whose only parameter is MTT. For the case of OUT_S15, the MTT estimation (using GM or EPM, with α or η = 1, respectively) is 7.24 weeks. For stream water sites (except for the case of TTP-RV, which results were not considered for analysis due to the low NSE) it was easy to choose the best performing model: for NF-RV, SHA-RV and OUT-RV, according to NSE, the best performing model was GM (Table 3). Furthermore, the justification of model selection is described in Section 2.5.1 (P. 6, L. 29-32): 'Among the diverse model types, two-parameter models such as the gamma model (GM) or 30 the exponential piston flow model (EPM) are commonly used for MTT estimations (Hrachowitz et al., 2010; McGuire and McDonnell, 2006) and were identified by Timbe et al. (2014) as most suited to infer MTT estimations of spring, stream and soil water in an Andean tropical montane forest catchment.' We agree that 1.5 years of data is not so much and ideally a the data input should cover a period as long as or longer than the MTT, but one has to consider that very little, and in this case no data was available for the study region. Furthermore, due to limited funding and accessibility in such remote areas, it become challenging to collect a long-term dataset for stable isotopes. Considering the conditions in the study area and the requirements for MTT analysis, we think it is reasonable to present the estimated MTTs for the three subcatchments and main catchments as preliminary findings, as long as its uncertainty is emphasized.

2) I wonder if a first step should be a hydrometric analysis that compares land covers and that can informed the findings form the MTT in light of physical processes. In addition, there might be interesting patterns in the isotopic data alone in terms of means per location, per season, comparisons across soil, stream, groundwater, and precipitation that would allow contrasting the different land covers. I am looking a figure 3 thinking: there is many data that have not been appropriately described in the paper. My point is that the isotopic data can we used on other ways different from in convolution equation for MTT.

Reply: As suggested by other reviewers, we will expand the presentation of the raw isotope data to give it a more prominent position in the manuscript. This will hopefully also address the concern of Reviewer #4 that not all data has been described appropriately in the paper. While presenting the isotope data in more detail we will include the calculation and analysis of the Young Water Fraction (YWF) (Kirchner 2017) of the analyzed catchments.

3) The organization of the paper and its content is insufficient. a. The introduction is no short and does not set up the problem well. It is not clear what would the contribution of this study be nor how it fits with previous literature.

Reply: This will be addressed in the revised version of the manuscript.

4) Methods: It to short and refers the reader to a paper in review. A more comprehensive description is in order. The methods indicated that precipitation was estimated using Thiessen polygons based on the information (I assumed, from the nine tipping buckets) however the results from this analysis is never presented in the results section. How variable is precipitation in space and time in this system?

Reply: The current version of the manuscript is already quite long. The study area and collection of discharge and precipitation has been described extensively in other publications (e.g. Jacobs et al. 2017 and the manuscript under review, which is now published as Jacobs et al. 2018). We therefore decided not to repeat this in the current

manuscript. The precipitation results have indeed not been presented explicitly in the results, but differences in rainfall between the four catchments are displayed in Figure 4 as weekly precipitation. This also clearly shows the temporal variation in precipitation. We will consider presenting some of the information you request in a supplement, as we do not think that such detailed information is relevant for the manuscript without making it too long.

5) The result section is vague. For instance on 3.1. (Solute concentrations) the authors do not describe any one solute but instead talk all simultaneously as high or low. The result sections should include some actual numbers so that the reader knows what low or high mean. Likewise, there is no information in the results about how the values for the isotopic concertation vary in space and time per precipitation, stream, soil water, etc.

Reply: This will be addressed in the revised version of the manuscript. Similar to the precipitation data, more detailed information will be presented in a supplement.

References:

Hrachowitz, M., Soulsby, C., Tetzlaff, D., Malcolm, I. A. and Schoups, G.: Gamma distribution models for transit time estimation in catchments: Physical interpretation of parameters and implications for time-variant transit time assessment, Water Resour. Res., 46(10), W10536, doi:10.1029/2010WR009148, 2010.

Jacobs, S. R., Weeser, B., Guzha, A. C., Rufino, M. C., Butterbach-Bahl, K., Windhorst, D. and Breuer, L.: Using high resolution data to assess land use impact on nitrate dynamics in East African tropical montane catchments, Water Resour. Res., 54, https://doi.org/10.1002/2017WR021592, 2018

Jacobs, S. R., Breuer, L., Butterbach-Bahl, K., Pelster, D. E. and Rufino, M. C.: Land use affects total dissolved nitrogen and nitrate concentrations in tropical montane streams in Kenya, Sci. Total Environ., 603–604, 519–532, 2017.

McGuire, K. J. and McDonnell, J. J.: A review and evaluation of catchment transit time modeling, J. Hydrol., 330(3-4), 543-563, doi:10.1016/j.jhydrol.2006.04.020, 2006.

Timbe, E., Windhorst, D., Crespo, P., Frede, H.-G., Feyen, J. and Breuer, L.: Understanding uncertainties when inferring mean transit times of water trough tracer-based lumped-parameter models in Andean tropical montane cloud forest catchments, Hydrol Earth Syst Sci, 18(4), 1503–1523, doi:10.5194/hess-18-1503-2014, 2014.

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