Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2018-61-AC3, 2018

Hydrology and Earth System Sciences
Discussions
Open Access

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.

Suzanne R. Jacobs et al.

suzanne.jacobs@kit.edu

Received and published: 8 April 2018

We would like to thank Reviewer #3 for the feedback provided and will respond to the major comments provided by the reviewer. Other suggestions, e.g. presentation of the raw data, clarification of the abstract, improvement of structure of introduction, revision of the hypothesis, will be incorporated in the revised version of the manuscript.

1) The mean transit time (MTT) estimates based on a data set covering ca. 1.5 years are likely to be highly uncertain.

Reply: With respect to the concern of Reviewer #3, about the limited sampling period

Printer-friendly version

Discussion paper

(1.5 y), in a revised version of our paper we will point out that present MTT estimates for stream water, are meant for a general characterization and comparison of the travel times of water between the studied sub-catchments, for stationary conditions. We will also emphasize that although preliminary, this information will serve as baseline for future research in which methods like time-variant techniques, could be used. We will emphasize that such approaches could serve as better tools to study the associated effects of land use on travel times or water flow paths.

2) This is evident, for instance, in the similar numbers of NSE, RMSE and Bias for the streamwater and soil water samples at the sites SHA and TF (Table 3): While streamwater was sampled weekly at these sites (n>100), MTT estimates were similarly uncertain for streamwater as for soil water - from which only a small number of samples was collected (n<17)! Thus, based on the model performance criteria presented in the manuscript, I would not strictly believe the values obtained for streamwater either.

Reply: We would like to clarify that the goodness of fit (NSE), RMSE and Bias, are not the same for soil water and stream water. Since the observed isotope signals of soil water have a larger amplitude than of stream water, estimations of MTT of soil waters have, in general, higher NSE, but also higher values of RMSE and Bias. Further, neither the associated uncertainties of estimations of MTT for soil water are comparable to those of stream water: uncertainty ranges for stream water (Table 3) are expressed in years while for soil waters are of the order of weeks (Table 4). Regarding the number of observation samples taken for the convolution approach in order to estimate MTTs, for stream water we took n = 75 samples for each of the four evaluated catchments (not n> 100 as being suggested by Reviewer #3), while for MTT estimations of soil water sites, the number of samples was n = 47 (not n <17 as it is stated by the Reviewer #3). For soil water sites, a larger number of samples was not possible since there were weeks in which the mobile soil water collected by the wick samplers was insufficient or non-existent.

3) Although the authors elaborate on the shortcomings of their data set with regard to

estimate MTTs (Sect. 4.3), they do not consider using an alternative approach such as the young-water fraction framework (Kirchner, 2016a, b). This framework uses the seasonal cycle amplitudes of streamwater and precipitation amplitudes to estimate the fraction of water younger than ca. 3 months. Thus, with the data set presented by Jacobs et al., such an analysis might result in estimates of the young-water fractions of streamwater that are more robust than the MTTs. (Using the soil water samples from the sites NF and OUT might also reveal some interesting results, however, the data from the sites SHA and TTP are clearly too incomplete for such an analysis.)

Reply: In a revised version of our paper we will include estimations and the respective analysis of the Young Water Fractions of streamwaters (YWF). The base of our analysis will be the amplitudes of the observed isotopic input and output signals, and according to the criteria established by Kirchner (2017). A preliminary estimate has been already posted as part of the reply to comments of the Reviewer # 1.

4) In the catchment SHA, the samples from a wetland (WL, n=4) and the shallow well (WE.b, n=2) comprised two important end-members in the 3-component mixing analysis, whereas no wetlands or shallow wells were sampled in the other two catchments. Thus, I question the comparison made between the three sub-catchments [. . .].

Reply: The main reason that no shallow wells or wetlands were sampled in the two other sub-catchments, was that there were no similar accessible wetlands in these two sub-catchments. Specifically the natural forest sub-catchment is highly inaccessible due to the dense vegetation and absence of footpaths. We assume, however, that springs and wetlands represent similar groundwater sources, as supported by their similar chemical composition (P. 10, L. 3-4) and are therefore comparable between the three sub-catchments. This hopefully also clarifies the reviewer's comment: '[. . .] wetlands were only analyzed for one catchment (SHA), and in the Abstract it appears as if wetlands and springs were considered equivalent end members'. With regards to shallow wells, as mentioned in the discussion (P. 12, L. 8-9) there are no shallow wells in the forest, because of absence of habitation, and within the tea plantations

Printer-friendly version

Discussion paper

shallow wells are not present as all settlements have access to piped water. Therefore, although we tried to include similar end members for each sub-catchment in the design of the study, we were limited in the availability and accessibility of end member sampling sites. We acknowledge in the discussion that it is likely that end members are missing due to e.g. lack of proper groundwater access and that the results have therefore a quite large uncertainty.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-61, 2018.

Printer-friendly version

Discussion paper