

Interactive comment on “Hydrograph separation and scale dependency of natural tracers in a semi-arid catchment” by R. Bohté et al.

Anonymous Referee #2

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General comments:

The manuscript describes a dataset of discharge and natural tracers used for hydrograph separation in 3 sub-catchments in Tanzania. The data set consists of discharge timeseries at two points and 4 automatic rain gauges over an area of 23 km². Additional data was collected manually: daily rainfall accumulator amounts and water samples at 12 locations, water samples of base flow and event flow at 4 locations as well as seasonal samples for 21 springs. In a piezometer of the headwater catchment water levels were also recorded manually twice a day and groundwater was sampled twice a week.

Scale effects are discussed by comparing separations between the three subcatchments, which results in two different spatial scales. However, the results seem incon-

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clusive and should be discussed in more detail and also with respect to the related uncertainties. The conclusion that spatial and temporal variability of end member concentration has an effect on the larger scale but not on the smaller scale, the headwater catchment, needs to be elaborated further. Furthermore, the study struggles a bit with the data scarcity of the area, as no discharge time series exist for the two larger subcatchments, just for weir a little further downstream on the main stem.

While the concepts, ideas and tools used in the study are not novel, I am assuming the data set is noteworthy in a region which can probably be considered to be quite data scarce. However, these issues are not discussed in the manuscript.

The introduction is very short and does not discuss scale and uncertainty issues as investigated by prior studies. The very general section on hydrograph separation in the methodology also includes a literature review on hydrological processes which could be moved into the introduction.

The experimental methods section is a bit unstructured and hard to follow, especially as the map of the catchment and the measurement locations was incomplete (the subcatchments should be indicated here) and very hard to read, partly because it was much too small and also because of the very intensive colour shading. Sampling and measurement points should be named and always referred to by this name in both text and map. It would help if the data set was also summarized in a table including type of measurements, temporal resolution, sampling points, sampling frequency, etc summarized for each subcatchment separately. Some of the methods are also explained in the results section.

The conclusion section summarizes the results, but their novelty, scientific significance, comparison with the results of other studies on this topic and larger implications should also be discussed. The problem of temporal and spatial variability of end member concentrations has also been found in other studies and the results should be discussed in this context.

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The figures should be improved according to the comments below.

Specific comments:

p.1344 l.12-14: unclear, there is information missing, please rephrase or remove this sentence

l.14: what does "This" refer to

l.14-15: were the 20% event water determined at the weir itself? You should also say if this refers to one or several events.

l.16: preceding wetness conditions – as I understand it you did not look at wetness conditions but just at antecedent rainfall?

l.18-20: unclear, please rephrase

p.1345 l.15: This sentence is unclear, it should be rephrased and the topic discussed with a bit more detail.

p.1346 l.15-23: Please describe in more detail the research catchment itself instead of the entire Makanya catchment.

p. 1347 l.22: how did you prevent evaporation from the accumulating rain gauges? Have evaporation measurements been carried out in this area?

p.1348 l.18: it would be easier to understand and follow the chronology if you named the seasons according to their characteristics, maybe "wet season OD" and "wet season MM" or first and second wet season.

l.24: when was this 4 day field campaign and is the data shown in the results section?

p.1349 l18-p.1350 l.19: This part could be moved to the introduction

p.1350 l.10: only three studies have used hydrograph separation in semi arid areas? Why is that? Please explain this surprising lack of studies.

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p.1351 l.15-17: please explain how different it is to carry out this type of study in a semi-arid area compared to temperate regions. What are the specific challenges you are faced with here?

l.21-22: please identify the tipping bucket by name and indicate it on the map; what season is this referring to? Please also include the year in these dates.

p.1352 l.1: what are the two stations you are referring to here? Please give names and indicate on the map.

l.3: please define the time period of the investigation period in the methodology.

l.6: please also report the $\delta^{18}O$ values not only deuterium (also in the plots). This way the two separations can be compared.

l.14: the 55% of pre event water – what tracer is this referring to?

l.20-22: please explain this finding

p.1353 l.2-3: how were the contributions of the two subcatchment determined? This should be explained in the methods section.

l.20: the threshold seems to refer to the headwater catchment while the results refer to the two large subcatchments. Please explain what parameter and location this threshold refers to.

l.27: the sudden drop is not apparent in the data as there is a data gap just before the event. The upper corner of the stepfunction does not seem to be supported by a data point.

p. 1354 l. 16-19 and 25-27: this should go into the methodology section

p.1355 l.3: please also give the areal precipitation

p.1356 l.12-14: how did the other constituents behave? Did they show the same spatial patterns as the SiO_2 ? Maybe you could also say something about these spatial

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patterns when you plot them on a map. Are the higher/lower concentrations found in the same area, are there spatial clusters?

p.1358 l.5-7: " The assumption that the end-member concentrations are constant over time and in space was not met at the larger scale." – did you check if this assumption was actually met at the smaller scale? Please explain

l.17 please explain why you trust the separation with SiO₂ despite the fact that it also shows significant spatial variability.

l.23: "at the smaller scale the spatial variability could be negligible..." – is this an assumption? Please explain.

Table 1: how was total runoff determined /how was the end of the event determined? How was the runoff ratio calculated? This should be explained somewhere.

Table 2: please also give the amount of areal precipitation over the entire catchment as this was probably used for the determination of the runoff ratio. It should be mentioned that the peak discharge rate was measured at the main weir. Is the runoff coefficient referring to the same thing as the runoff ratio in table 1? Please use consistent terminology.

Figure 1: much too small and difficult to read. Subcatchment boundaries are missing.

Figure 2: The left and the right side of the figure are not aligned. Indicate the time period used for the right side plots on the plot of the entire time series. Please add data points to the left side plots. For the chemistry data it is unclear if the flat lines are due to interpolation or if they are actual measurements. Please also show the 18O data. Please explain what the arrows in the deuterium plot refer to.

Figure 3: why is the event water fraction determined with EC so high for the time of peak?

Figure 4: please show the data points for SiO₂ and Deuterium. The figure is very small,

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I cannot read the x axis labels on the print out.

Figure 5: what are the sudden declines in Q after peak 2 and peak 3? Why do you plot a step function for the groundwater time series?

Figure 6: I think the steep sudden decline to the first data point of EC and SiO₂ measured during the event is misleading as there is no data point at the upper end of this sudden drop. The two green lines in the uppermost plot cannot be distinguished. Please also add the pre event /event water separation for the entire catchment based on the chemistry of the samples at the weir.

Figure 7: please add in the caption how many stations were sampled per event.

Figure 8: the legends are much too small.

Technical corrections:

p.1344 l.8: better "the sources contributing to runoff"

l.9: techniques should be singular

l.15&16: the Vudee sub-catchment, the Ndolwa sub-catchment

l.24: better "This study" instead of "This research"

p.1349 l 18: rephrase the beginning of the sentence

p.1350 l1: the parenthesis starting here is not closed

l.13: rephrase – this is unclear

l.18: rephrase - unclear what exactly is meant here

p.1351 l.10: mix instead of mixed

l.15 spatially instead of spatial, depending on instead of related to

p.1356 l.3: I can only find 4 stations on the graph

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l.12: were analyzed for

l.13: give the number of the springs sampled 3 times here also.

l.18: what does samples refer to here – different springs or different times?

Section 4 should be called Summary and Conclusions as there is a large emphasis on the summary part here.

p.1357 l.21: better: “where the runoff increased. . .”

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