

Interactive comment on “Plant water resource partitioning and xylem-leaf deuterium enrichment in a seasonally dry tropical climate” by Lien De Wispelaere et al.

Anonymous Referee #1

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GENERAL COMMENTS

The manuscript presents a straightforward and interesting study of deuterium (and ^{18}O) concentrations in leaves, xylem and source water at different habitats of a crater lake at the foothills of Mt. Kilimanjaro. Analyses of heavy isotopes are a potentially very promising tool for eco-hydrological assessments, e.g. regarding the partitioning of soil water among plants. The authors investigate differences in deuterium concentrations among habitats, growth forms, types of leaf phenology and species. The study is also somewhat intended as a baseline study to investigate the potential of heavy isotope analyses of n-alkanes in leaf waxes for paleoclimatic reconstruction. Even though this remains relatively vague throughout the manuscript, the study constitutes an important

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contribution of field-measurement based results to the scientific community involved in heavy isotope analysis and its applicability to ecological research questions. The manuscript is well-written and clearly structured, but could partly be improved with regard to language and readability, more methodological detail and references as well as a more clear, overarching message for the scientific community that is to be drawn from the presentation, discussion and conclusion of the presented data.

1. Does the paper address relevant scientific questions within the scope of BG? As an eco-hydrological baseline study aiming to investigate partitioning of source water by analyses of heavy hydrogen and oxygen isotopes, it certainly falls within the scope of BG, covering the field of plant-soil interactions.
2. Does the paper present novel concepts, ideas, tools, or data? The study presents interesting new data from three habitats at the foothills of Mt. Kilimanjaro and gives an outlook of the potential future applicability of isotope analysis in paleoclimatology, i.e. the analysis of heavy isotope concentrations in n-alkanes of leaves to reconstruct past climate, as a relatively novel concept to which the study aims to contribute baseline data.
3. Are substantial conclusions reached? The authors present supporting results for the ‘two water world’ hypothesis, and they present methodologically sound results on differences in xylem and leaf deuterium concentrations in plants from different habitats, of different growth form and leaf phenology. However, no substantial new insights or overarching conclusions are reached, and the conclusions for the scientific community from these results, e.g. for the paleoclimatic community, could be discussed and delivered in an improved manner.
4. Are the scientific methods and assumptions valid and clearly outlined? The methods are well-described, clearly-structured and feature appropriate references. In some parts, it might be interesting to see a little more current references, if available. In other parts, more detail and references could be added (see details in ‘specific comments’)

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below).

5. Are the results sufficient to support the interpretations and conclusions? The results are described in a very clear way. They do, however, not yield very clear trends, e.g. among habitats, growth forms or leaf phenologies. It is thus difficult to derive strong, overarching conclusions for the scientific community. However, this could be discussed in more detail, if nothing else e.g. regarding what further studies should focus on, and what potential limitations of the study there could have been.

6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? Yes, with very few small exceptions (see in 'specific comments' below), the methods seem very solid and reproducible.

7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? Yes, appropriate references are cited with regard to other studies, and the novel data of the authors is clearly delineable.

8. Does the title clearly reflect the contents of the paper? Yes.

9. Does the abstract provide a concise and complete summary? The abstract gives a complete and concise overview of the results; maybe a final sentence with regard to overarching conclusions/interpretation of these results could be added (also see 'specific comments' below).

10. Is the overall presentation well-structured and clear? The manuscript has a very clear structure that it consistently keeps it each of its parts. It is thus very understandable and pleasant to read.

11. Is the language fluent and precise? Overall, the language is understandable and precise. There are several smaller issues (see "technical corrections") that could improve readability, e.g. with regard to cutting longer sentences in two, putting commas, or partial rewording. I included several suggestions on how to improve the language

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of the manuscript further, some of which might be considered merely a question of style or taste, but others of which should be considered. A final proof-read by a native speaker could also further improve the language.

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? Yes.

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? There are some small suggestions with regard to clarifying some of the figures and captions (see 'specific comments').

14. Are the number and quality of references appropriate? Yes, references are numerous and their overall quality is appropriate.

15. Is the amount and quality of supplementary material appropriate? There are two interesting supplementary figures.

SPECIFIC COMMENTS

Abstract

Line 28: 'The enrichment in deuterium from xylem water to leaf water averages $24 \pm 28 \%$.' The abstract is very understandable so far. However, this sentence presents a number which, without previous knowledge, is very difficult to place. Perhaps the authors could focus on the interpretation of this value (and its high variability) rather than merely providing it uncommented.

Line 31: The authors later claim that paleoclimatological considerations were one reason for the study. This could be mentioned in a final, somewhat overarching sentence to these conclusions, including the actual implications of the results of the study for the scientific community in general and the paleoclimatological community in particular.

Introduction

Lines 36-38: This sentences could be strengthened with a reference, e.g. if available a

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review study on heavy isotope research.

Line 50: The provided reference is quite old (1985), which is not a problem per se, but does make one wonder whether there may be more up to date references that either prove or challenge this assumption?

Line 58: A reference could be added to strengthen this point. Maybe, even a half sentence explaining how evaporation is expected to change the composition could be useful here?

Line 64ff: The authors mention the application of hydrogen isotope geochemistry for paleoclimate research and put some stress on the fact that their study can be considered a baseline study to advance this field. Maybe the reader could profit from a short sentence with a bit more detail or examples of such potential applicability. Furthermore, considering that this seems to be one of the aims of the study, it could use a bit more detail also in the discussion, conclusion and maybe even a summarizing, final sentence in the abstract, that points out the conclusions and implications of this present study for further research and the paleoclimatologic community.

Line 68: 'during which little precipitation falls...': Little is a very relative term and could maybe be defined in a bit more detail (e.g. < XX mm/month).

Line 71: Does this limited competition refer to competition among species, or among individual plants? I would try to clarify this a bit more...

Line 78: '...in several plants...': it may sound more interesting to provide a bit more detail here, e.g. 'in XX individuals of XX different species from three distinct habitats...'

Line 82: As already suggested for the end of the abstract, a final, overarching sentence focusing of the goals for the scientific community, the novelty of the study, potential implications and applicability for the paleoclimatic community etc might be beneficial to round off this otherwise very solidly formulated and clearly structured introduction.

Methods/Materials

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Line 87: It seems that the 'long rains' (2.5 months) are not much longer than the 'short rains' (2 months)... Are these local terms for the seasons? As this could seem confusing, I would recommend sticking to a bit more clear terms, consistently applied throughout the manuscript, e.g. '(long) SE monsoon rains' vs. '(short) NE monsoon rains'.

Line 92: 'annual lake-surface evaporation of c. 1735 mm': How was this value derived/calculated? Or is there a reference?

Line 106: I recommend at a later point (see Figures) to if possible include some rough indications of the distribution of the different land use types in the map, e.g. also different agricultural uses. If this would be possible, the map could be linked in the text here.

Line 120: As lake water seems to only be sampled one single time, it would be good to argue here as to why it would be expected that this is representative, i.e. ground water compositions stable over time.

Line 120: As in the following paragraphs, there seems to not be much detail on sample handling and processing procedures, either in the form of concise descriptions or by providing references and referring to standard procedures.

Lines 126ff: This section could use a bit more detail, e.g. with regard to how the locations were chosen (randomly? arbitrarily?), what considerations were behind and how representative they are for the respective vegetation types. Then, how were the plants within the vegetation types chosen? Were there any further criteria? Also, how was the abundance of species assessed? Merely visually, or were there inventory data at hand, e.g. from previous studies? How common was it that 3 individuals of one species could not be found?

Lines 135ff: In general, the materials and methods (especially this last paragraph) could use a bit more detail and references, particularly with regard to the considerations

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behind the applied methods as well as their potential limitations, uncertainties and challenges... Schwendemann et al. (2010: Can deuterium tracing be used for reliably estimating water use of tropical trees and bamboo?) e.g. provide the information that their measurement precision was 2%%.

Line 138: Again, a reference outlining whether this is standard procedure would be helpful. Same for the following sentence: either an explanation on whether this standard protocol, or a reference, or a bit more detail, on how and why and what is important and the considerations behind.

Line 140ff: What kind of leaves were sampled? (randomly? sun exposed? why?) Include reference to standard procedure, or a bit more detail on the considerations behind (if possible also including references).

Line 145f: It feels like this sentence is more more part of sampling/handling than of analysis. . .

Line 151: The authors claim that 'in this paper, isotopic composition is expressed in terms of . . .'. Does this approach differ from other papers? If so, why?

Results

Line 181: mm of precipitation of the dry months would also be interesting here to provide a contrast, as highest values are provided.

Lines 182ff: Precipitation (previous sentences) is of great interest, but the detailed description of temperature is absolutely necessary? Or could this paragraph even be moved to the methods? Is it, particularly the temperature part, essential for later discussions?

Line 188: 'varied by more than 84 %': while this absolute value is certainly of interest, it might also be interesting what this means in relative terms (e.g. x-fold variation, or in % normalized my mean, or similar) to give a more simple to grasp impression of the high occurring variability.

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Line 193: Are these considerable differences statistically significant? If so, I would mention it.

Line 193: 'In order to draw a reliable LMWL, . . .': would it not have been more reliable if precipitation would have been sampled directly at the study sites? I would remove the word 'reliable'.

Line 204: When did the groundwater composition show these values? Can they be expected to be stable over time? Also see issues addressed in methods.

Lines 230f: Rather than absolute standard deviations (or standard errors, which is it? And among what, days? Months?), it could also be interesting to provide these ranges of temporal variability in relative terms, e.g. by providing the coefficient of variation rather than absolute SD/SE.

Line 233: 'degree of evaporation' of what? A given water sample? How does this parameter describe it (i.e., what do low/high 'values actually mean). At least in the methods, I bit more brief details on the considerations behind and the interpretation of this value might be helpful.

Lines 242ff: 'Finally, among the seven non-grass plant species sampled at the crater rim, a significant difference ($p < 0.01$) was observed between the low ED value for *Vepris uguenensis* (9 ± 7 %) and the high ED value for *Euphorbia tirucalli* (25 ± 7 %.' Is this really of significance? Does it tell anything for later, the discussion, conclusions? Or is it merely a significant, but un-interpretable difference that could also be left out?

Line 270: ' . . .the $\delta^{18}\text{O}$ is not reported here. . .': it is generally not reported much in this study. Why is that? What are the considerations behind? Maybe this could be included in a short sentence in the methods.

Line 277: The provided p-value refers to what exactly? Averages of wet/dry season, or specific months?

Discussion

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Line 290: 'other phenomena': For example what kind of phenomena'? Is this in line with other studies?

Line 300: How much drier than usual? Could this be quantified, e.g. in % of long term precipitation?

Lines 305-307: As mentioned before, the (expected) temporal/intra- and inter-annual variability of the groundwater need to be briefly addressed either in the methods or here. Is the singular sampling scheme sufficient? Why?

Lines 336f: Not entirely clear from here, the connections could be made a bit more clear here: similar temporal depletion > similar vertical profile expected. plants with groundwater access > depleted xylem water. But why is the precipitation on Mt Kilimanjaro more depleted? How is the local recharge mechanism in the region? A bit more detail might be of interest.

Line 357: It does not really become clear from this sentence how stem water storage and shallow rooting depth in large trees could be connected.

Line 372: If this precipitation water is retained, then how does it get to the xylem signature? This could be formulated more clearly. As the empty pool is supposed to be refilled annually with the November rains, it also doesn't sound right that it would be retained through several seasons. Needs better explanation.

Line 381: '...site at the foot of the crater has deeper soils.' And thus lower fluctuations in soil moisture? What is the connection?

Line 382: '...our data seem to confirm...': The authors present a quite large data set in this study. What exact data does/does not confirm this hypothesis? All of it?

Line 399ff: The values of the presented study actually seem to be quite distant from arid and lie exactly in temperate... the sentence should thus be rephrased.

Lines 402f: A bit more detail would be helpful, as in how would difference in these

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variables be expected to influence seasonality/induce temporal variability in deuterium leaf concentrations? Please discuss a bit more.

Lines 405ff: '...highly diverse leaf morphology large variations in $\delta^2\text{H}$ leaf between plant species are expected...': was this confirmed by the results? Could be sold better if so, has to be discussed if not... This seems to be discussed in the next paragraph, maybe it would be possible to move it there or combine it better...

Line 407: As this is a methodological strength, it could possibly be sold better, e.g. along the lines of 'To eliminate additional variability induced by previously reported large diurnal variations in leaf deuterium, our samples...'

Line 456: 'Despite its enormous potential, hydroclimate interpretations remain troubled by uncertainties 455 in the effects of past variation in water source $\delta^2\text{H}$, xylem-to-leaf $\delta^2\text{H}$ enrichment, and the biosynthetic isotopic depletion which occurs during n-alkane synthesis (Sessions et al., 1999; Liu and Yang, 2008; Smith and Freeman, 2006; Sachse et al., 2012).' A bit more detail, also with regard to more clear conclusions and recommendations for further studies, would be helpful here.

Conclusions

Lines 475ff: Largely a summary and no real, graspable conclusions. Particularly towards the end, add what was learned from the study, what is important for the community, what were the objectives accomplished, and how does this issue need to move on in future studies? This could also come back to the original 3 objectives as mentioned in the abstract: what was specifically learnt for spatial/temporal variability in water resource use, is precipitation composition reflected in the xylem and, lastly, what influences xylem-to-leaf enrichment.

Figures

Line 770: The map on the right side could profit from (approximately) distinguishing land use types/vegetation forms, e.g. with fine lines and also including the lowland

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agriculture mentioned in the study site description.

Line 790: Figure 4: Similar to the small numbers (n) provided in the figure, it could potentially be interesting to also provide the average monthly precipitation in mm?

TECHNICAL CORRECTIONS

Introduction

Lines 38-42: The word 'in' should be added twice in this sentence (e.g. fluctuations in the degree of rainout. . .): 'The hydrogen and oxygen isotopic composition of precipitation varies both spatially and temporally, due to fluctuations i) at the site of evaporation, e.g. in meteorological conditions such as relative humidity (RH), wind and sea surface temperature; and ii) at the site of precipitation, e.g. in the degree of rainout of particular air masses (Craig, 1961; Dansgaard, 1964; Gat 1996; Araguas-Araguas et al., 2000, Gibson et al., 2008).'

Lines 46-47: 'This is in turn used to compare different (sub)surface water bodies with local precipitation (Rozanski et al., 1993; Breitenbach et al., 2010).' Maybe this could be formulated a bit better, e.g. along the lines of 'LMWLs can be used to compare different. . .'

Line 49: 'rooting depth' instead of 'root depth'?

Line 50: add comma after bracket: '...1985), so that...'

Line 51: add 'composition of': '...of xylem water represents the composition of the plant water source...'

Line 52: rephrase slightly, e.g.: 'Fractionation during root water uptake has thus far/so far/previously only been found for plants living under xeric conditions...'

Line 53ff: I would suggest to slightly rephrase and cut the sentence in two to enhance readability. E.g.: 'In contrast, the isotopic composition of leaf water differs markedly from that of xylem water. This is because during transpiration in leaves,

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lighter molecules diffuse more easily to water vapor than heavier ones.' Or even: '... This is because transpiration in leaves discriminates towards lighter molecules, while heavier isotopes (tend to) remain.'?

Line 55f: I would again restructure the sentence slightly to improve readability, e.g.: 'The degree of enrichment (from xylem to leaf) is a function of / mainly depends on temperature, RH and the isotopic composition of the water vapor surrounding the plant...'

Line 62f: This sentence could be modified by adding/changing some words and restructuring a bit, e.g.: 'Consequently, a better understanding of hydrogen fractionation during its incorporation from precipitation over leaf water into plant leaf waxes is needed. The present study...'

Line 68: I would take out the word 'useful' and merely start the sentence with 'Adaptions to...'

Line 70-74: I would restructure and partially reword the sentences slightly to improve readability, e.g.: 'Meinzer et al. (1999) suggested that, at least in pristine dryland ecosystems, competition for water may actually be limited due to pronounced spatial and temporal partitioning of water resources resulting from maximized species diversity. It furthermore appears that the relationship between root biomass in a particular soil layer and contribution of that soil layer to plant water uptake is not always straightforward (Jackson et al., 1995; Stahl et al., 2013).'

Line 75: I would add 'analysis of the' and 'tool': '...Therefore, analysis of the dual stable isotope composition of xylem water could be a valuable tool...'

Line 77: add 'content/fraction/concentration' after '...2H and 18O...'

Line 78: cut into two sentences and provide a bit more detail, e.g.: '...around Lake Challa. Sampling was carried out/performed monthly/bi-monthly/every x months during successive wet and dry seasons of one complete year.'

Methods/Materials

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Line 90: Add 'values/temperature' after '...and highest...'

Line 93: 'which is mainly derived' sounds a bit strange in this context, maybe replace with e.g. 'which main source is precipitation...'

Line 97: add comma: 'a dry forest occurs, with succulents such...'

Lines 102ff: I would slightly rephrase, e.g. to: 'The stunted, fruit tree-like appearance of the woody species, mainly Combretaceae, Burseraceae and Anacardiaceae, inspired the first botanists to describe this vegetation formation as 'Obstgartensteppe' ('fruittreegardensteppe'; Volkens, 1897).'

Line 113: 'from entering' instead of 'enter'

Line 114: shorten to '... , which could alter isotopic composition of collected water (Friedman et al., 1992).'

Line 117: replace 'monthly' with 'on a monthly basis'.

Line 119: no comma: 'the lake on a monthly basis from...'

Line 121: Throughout the manuscript, there are references to the 'rain season' as opposed to the 'dry season'. I believe the correct term would be 'rainy season'? It does appear correctly in other parts of the manuscript. Please use consistently.

Line 139f: reword slightly for better readability: 'In the case of smaller trees and shrubs, a piece of twig was sampled, the outer layer was scraped off using a knife and it was enclosed into sealed vials...'

Line 142: change to: 'From grasses, only leaves were sampled.'

Line 154: , change to: '... which, by definition, has H and O concentrations of 0%%...'

Line 154: I would start a new paragraph at the end of line 154, as the topic shifts to the enrichment factor.

Line 156: maybe the (Eq.1) bracket should appear behind the actual equation?

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Line 168: add 'i.e. the higher the ratio/proportion/concentration of heavy isotopes.' to the end of the sentence for a bit more clarification?

Line 172: replace 'or' with 'and'

Lines 174f: slightly reword to 'A discussion of the different slopes and intercepts is not scope of this paper, but they were used to calculate δ^{2175} HLMWL-int.'

Results

Line 182: take out 'slightly'

Line 189: 'sampling period' instead of 'sample period'?

Line 208: as the mean value is actually not shown in the figure, I would move the link to the figure to a different place in the sentence.

Line 208f: As it actually does not vary considerably among all habitats, I would rephrase to: '... δ^2 Hxylem varied between plants at the lake shore ($-2 \pm 10 \text{ ‰}$, $n = 48$) and isotopically more enriched plants in the savannah ($-25 \pm 12 \text{ ‰}$, $p < 0.01$, $n = 34$) and on the crater rim ($-26 \pm 15 \text{ ‰}$, $p < 0.001$, $n = 72$).'

Line 210: remove 'Also...', start sentence with 'The...'

Line 214: replace 'caused no significantly different' with 'did not significantly influence 2Hxylem values...'

Line 215: replace 'an effect of season' with 'seasonality in 2Hxylem'?

Line 215: replace 'tree' with 'species' or 'tree species', also in line 218

Line 222: I would move the (Eq. 2 and 3) bracket behind the word 'estimate'

Line 228: replace 'between' with 'among' (more than two), and take out the following word 'the'. I would also replace 'according to' by 'analyzed by'.

Line 233: Split sentence in two: '...degree of evaporation. It is derived...'

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Line 237: slightly rephrase to 'Growth form also influenced ED ($p < 0.05$), with lower values for shrubs than...'

Line 241: replace 'however' with 'but'

Line 242: take out 'Finally. . .', start sentence with 'Among. . .'

Line 247: cut sentence in two: '...two species of grasses. Across this complete. . .'

Line 248: it should be either 'ranged from. . .to' or 'varied between . . .and. . .'

Line 257: 'had' instead of 'have'?

Line 260: insert the word 'species' after 'shrub' and 'tree'?

Lines 263/264: I would take out the word 'most' in both lines

Lines 264/265: if 'respectively' appears at the end of a sentence, a comma should appear before it ('. . ., respectively.')

Line 269: cut sentence in two: '...and $\delta^2\text{Hleaf}$ values. This yielded an average. . .'

Line 271: technically, the difference is not significant among all habitats (see comment before), so that maybe the sentence could be rephrased, e.g. significant difference between x (. . .) and y and z (. . ., respectively). . .

Discussion

Line 287: the word 'However' should be followed by a comma ('However, . . .').

Lines 294f: rephrase slightly, e.g. to: '...(2014), the 2013 rainy season started in mid-November instead of late October and was thus delayed by 2-3 weeks.'

Line 295: Start next sentence with 'Additionally, it already ceased in...'

Line 296: cut sentence in two: '...earlier than normal. Rainfall amounts. . .'

Line 297: add comma: 'In addition, the 2014 long. . .'

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Line 299: add comma: 'On the other hand, the month. . .'

Line 299: change to 'main dry season from July to September. . .'

Line 300: change to 'The $\delta^2\text{Hprec}$ and $\delta^{18}\text{Oprec}$ in the dry month of July were clearly more enriched than the corresponding. . .'

Line 304: remove comma

Line 311: 'very similar': again, a bit of a quantification might be interesting (e.g. within/varied less than 5%? 10%?)

Line 313: the previous sentence states that the seasonality is very small. Now it is described at modest. This should be worded more clear and consistently.

Line 322: I would replace the word 'reduced' with 'similar' or 'similarly small'

Line 323: an additional clarifying half-sentence relating and interpreting this may be helpful, e.g.: '... signature of xylem water, $\delta^2\text{Hxylem}$, when compared to e.g. the seasonality of plants using temporarily more variable surface water.'

Line 343: add comma after bracket: '...), allowing. . .'

Line 344: add 'e.g.' after 'as'?

Line 344: change to '...in a tropical moist lowland forest in Panama.'

Line 345: change to 'However, in line with our results in a tropical dry lowland...'

Line 345: move 'also' behind bracket

Line 349: change to '...use more topsoil water enriched in heavy isotopes by evaporation.'

Line 349: next sentence, begin with 'In contrast, in the savannah no such. . .'

Line 351: change to: '...shrubs allow them to access deeper. . .'

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Line 351: next sentence start with 'however': 'However, Meinzer et al. ...'

Line 352: rephrase to: '...found smaller trees to use deeper sources of water than larger trees, and attributed this to three possible factors.'

Line 353: replace 'first' with 'firstly/secondly/etc'

Line 356: add 'the': '...water content of the topsoil.'

Line 356: add 'storage': '...stem water storage capacity...'

Line 360: 'In this study...' could be confused with the study by Goldstein mentioned in the previous sentence. Maybe better 'In our study...?'

Line 360: put plural: '... evaporative distances...'

Line 361: 'were' instead of 'are'? (make this consistent throughout the manuscript, there still seem to be some small inconsistencies).

Line 363: add 'the' before 'former'

Line 368: add comma after 'Probably, ...'

Line 370: cut sentence in two and rephrase, e.g.: '...distinct 4-month long dry season. They are thus expected to recharge soils to a relatively large degree.'

Line 370: add comma after parantheses: '...(2010), who...'

Line 379: 'was' instead of 'is'? same in following line.

Line 379: add comma after '...mean $\delta^2\text{HLMWL-int}$, and the compound...' and adjust slightly

Line 380: add 'the': '... than in the savannah.' Continue with comma after 'Probably, ...' in next sentence.

Line 382: add comma after 'hypothesis'.

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Lines 391f: adapt slightly to '...high drought tolerance as its leaves wither and die (i.e. become deciduous) under extremely dry conditions while the stem...'

Line 394: delete the word 'is'

Line 404: add 'the': '... account the highly...'

Line 406: replace 'are observed' with 'have been reported'

Line 415: comma after 'Thus, ...'

Line 416: remove comma

Lines 416ff: slightly rephrase and cut sentence in two: 'Thus the adaptive traits of evergreens which reduce water loss and lower transpiration rates result in lower xylem-to-leaf deuterium enrichment. Extremely low $\delta^2\text{HLMWL}$ values of respectively $-24 \pm 30 \text{ ‰}$ and $8 \pm 15 \text{ ‰}$ were recorded for *Maerua* sp. and *Thylachium africanum*, two evergreen Capparaceae growing on the crater rim (Fig. 6). This is indicative of very limited evapotranspiration.'

Line 428: comma after 'Thus, ...'

Line 428: replace 'will' with 'could'?

Line 435: take out 'Also...', start sentence with 'The...'

Line 443: add commas: 'Meinzer et al. (1993), on the other hand, found...'

Line 443: cut to '...associated prevailing leaf phenology...'

Line 465: add 'that': '... but that not all...'

Conclusions

Line 466: add 'counterintuitively'? I.e.: '...with, counterintuitively, seasonally lowest isotopic values...'

Figures

C18

Line 770: Figure 1: figure legends of the map on the left side are very small and difficult to read.

Line 770: Figure 1: figure caption: year and citation of Wikimedia?

Line 770: Figure 1: figure caption: expand description of map on the right side a bit? E.g. 'Sampling sites in savannah, at the lake shore and on the crater rim are indicated by red dots.'

Line 770: Table 1: rephrase caption to: 'Studied plant species with their respective growth form, leaf phenology and habitat.'

Line 775: 'Only leaf water sampled': One might wonder why only leaf water was sampled in these species, maybe an explanatory half-sentence could be added for quick understanding when not having read the full article.

Line 780: Temperature a): symbols in this panel are somewhat similar and quite difficult to distinguish... it might be helpful to use a more distinct set of symbols, or work with differently shaded 'corridors' for the sampling period and historic data set, respectively.

Line 780: Rainfall amount b): The information transmitted by this panel is very valuable and clear. However, the 3 different types of precipitation bars in different shadings do make it a bit heavy to look at. I would e.g. suggest trying to color the bars with the highest relevance (i.e. the study period, 2014) black instead of gray (to draw the most focus), and change the color of 89-05 bars to white and of 2000-07 to a light gray.

Line 780: Figure caption: 'already started' instead of 'started already'

Line 790: Figure 4: caption: $\delta^{2}\text{HLMWL-int}$ should maybe not be abbreviated in the figure caption

Line 795: commonly, abbreviations (i.e. ED) are annotated on the y-axis. ED does not have any unit?

Figures in general: could it make sense in some of the figures to indicate statistical

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differences among habitats/growth forms/leaf phenology/etc by small letters?

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-354, 2016.

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