

Interactive comment on “A dual-biomarker approach for quantification of changes in relative humidity from sedimentary lipid D / H ratios” by Oliver Rach et al.

Oliver Rach et al.

oliver.rach@gfz-potsdam.de

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Dear Sarah, we want to thank you for the input on our paper. We understand your concern, and we cannot agree more, in particular for quantitative reconstructions we need to make sure no arithmetic errors are introduced. However, we want to clarify that we did all calculations using the correct mathematical approach (i.e. using the ‘epsilon’ formula for calculations with delta values) as emphasized by (Sessions & Hayes 2005). Therefore, our calculations would arrive at the exact same value as you do in your example calculation (i.e. “reviewer calculation”), and not at values you suggest if we would have used the incorrect mathematical expression (i.e. “author calculation” in the example spreadsheet added to the comment).

As such, no arithmetic errors were introduced into our model calculations.

For the estimation of ΔrH the only relevant equation is eq. 3, where we use the isotopic difference between terrestrial and aquatic biomarkers ($\delta^{2}H_{terr} - \delta^{2}H_{aq}$) as a measure of mean leaf water enrichment above source water ($\Delta^{2}He$), since this parameter goes into our final model (eq. 13). $\Delta^{2}He$ was calculated using the correct (epsilon) formula. These values are also equal to the $\epsilon_{terr-aq}$ data from (Rach et al. 2014). We adapted the use of ‘ Δ ’ instead of ‘ ϵ ’ here, based on the common use in the plant physiological literature (where the Craig-Gordon model has been extensively discussed).

We don’t think it would be helpful to add the exact mathematical expression to our equations because they would be extremely cluttered, we are also not aware this is done in the current literature. Instead, we work under the assumption, that any addition or subtraction involving delta values implies the use of the correct mathematical expression (even for carbon and oxygen data, although expected differences are minor).

In a revised version, we will add this information to the methods section, so that no further confusion shall occur.

Furthermore, we did not use the term “1:1 line” rather we refer to a “1:1 relationship”. In our understanding a 1:1 relationship is a simple source-product relationship (i.e. fractionation of a single component according to {Sessions:2005iu}), which is expected during a (simplified) biosynthetic reaction for example, without any other processes affecting it. This doesn’t have to lie on a 1:1 line (which in our understanding would have a slope of 1), and for delta values it actually shouldn’t, due to the mathematical issues dealing with ratios rather than absolute numbers. Possibly that is the source of confusion.

We will address the other issues raised by Reviewer 1 in a detailed response, when given the opportunity to respond by the editor.

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Oliver Rach, Ansgar Kahmen, Achim Brauer and Dirk Sachse.

Rach, O., Brauer, A., Wilkes, H., Sachse, D., 2014. Delayed hydrological response to Greenland cooling at the onset of the Younger Dryas in western Europe. *Nature Geoscience* 7, 109-112.

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