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Climate of the Past Discussions

Interactive comment on "Pollen-based temperature and precipitation inferences for the montane forest of Mt. Kilimanjaro during the last Glacial and the Holocene" *by* L. Schüler et al.

Anonymous Referee #1

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Reviewer statement on Schüller et al. "Pollen-based temperature and precipitation inferences for the montane forest of Mt. Kilimanjaro during the last Glacial and the Holocene"

The paper is based on modern pollen data collected with pollen traps from vegetation plots on Kilimanjaro. Such data is valuable and can be utilized in many ways. However, my recommendation is that the paper would not be accepted before major revisions. This recommendation is based on three main arguments.

1 - The sediment sequence on which the climate reconstruction is based is extremely sporadic. It spans two sections, one dating to 46-36 ka and the other 6-1 ka. Thus

the title of the paper is misleading and the abstract (stating "Our results. . .give highly interesting insights into the past 45 000 yr of climate dynamics in tropical East Africa") even more so – the paper gives only a negligible piece of data about the climate of the last glacial and only about few thousand years of the Holocene. Moreover, this core has been sampled from a "soil pit". It is unclear what type of sediment this represents - is it an organic soil layer, a peat sequence or what? If it is a soil deposit, it is likely that the pollen preservation has been poor and selective and the record is not suitable for quantitative climate reconstructions

2 - Too much critically important information is missing from the paper. It is clearly necessary to show the fossil pollen diagram on which the climate reconstructions are based and a diagram showing the values of the main pollen types in the traps used for constructing the calibration model. The radiocarbon dates should be shown as a table in the paper (now in the online supplement) and the procedure of age-depth modelling used for generating chronology for the reconstructions needs to be explained in the text

3 - Considerable parts of the quantitative data analyses and reconstruction procedure need major improvements and refinements. I will elaborate these methodological issues in my more detailed comments.

More detailed comments

-Page 196 "modern pollen-rain taxa" is a cumbersome term. Modern pollen taxa would be better.

-"Pollen assemblages in 28 pollen traps positioned on 14 montane forest vegetation plots were identified and their relationship with climate variables was examined". This is misleading, what the authors have done is to examine the relationship between pollen types and climate, not between pollen assemblages and climate

-page 197 Much of the introduction is about the basics and principles of organism-

based quantitative climate reconstructions. Many detailed reviews have been published about these issues and it is unnecessary to repeat these background topics here. It would be better to replace this by an introduction to the study at hand, especially about the earlier palaeoclimate studies on Kilimanjaro and the current main question in such research.

-page 200 Mt. Kilimanjaro is an ancient volcano. . .

-page 202. The soil pit from where the sediment core was sampled – describe the site and the sediment type. How large is the diameter of this pit? Is the sediment predominantly organic or inorganic? What is the pollen preservation? It would be important to show the sediment lithology and preferably the loss-on-ignition value of the core.

-page 202 The abstract indicates that there are a total of 28 pollen traps on 14 plots. This needs to be explained here in the methods as well.

-page 203 CCA with forward selection, a standard procedure in this type of research, was run for each climate variable and the pollen data. It remains unclear why different combinations of pollen types ("subsets") were used for reconstructing the three climate parameters. Why was 20% selected after the forward selection as the limit value for excluding some pollen types? Were these taxa selected from the fossil data for reconstructing each climate variable? If so, did you recalculate their pollen percentages so that the percentage sum of the used taxa was 100%? Variance partitioning with forward selection itself has been criticized recently as a potentially misleading approach for estimating the importance of the environmental variables.

-page 203 Species (pollen types) respond modes to the three climate variables are explored by fitting a local regression function. This is not a satisfactory analysis of response modes. The authors should instead use a hierarchical set of taxon response model (so called HOF models). With this technique it would be possible to explicitly explore the response mode and define the response model type for all pollen types in

their dataset. This is a robust and user-friendly method in paleoecology.

-there is a serious risk in the study that the three climate variables are strongly collinear, especially because they show markedly similar modern gradients (Fig. 2) and similar trends in the reconstructions, although the reconstructions are based on different calibration subsets. It is therefore difficult to assess how meaningful the results are. One methodological step that would need to be included in the study would be to investigate how much each variable accounts for variance in the pollen data by calculating the ratio of the eigenvalue of the first constrained RDA axis ($\lambda 1$) using each of the three climate variables as a single explanatory variable with the first unconstrained axis ($\lambda 2$). With such a test, a value of $\lambda 1/\lambda 2$ greater than 1.0 indicates that the variable of interest represents an important ecological gradient in the training set.

Tables – there is a confusion with the numbering of the tables. CCA results are shown in Table 1, not on Table 2 as indicated on page 204. Results of forward selection of pollen taxa are shown in Table 2, not in Table 3 as indicated on page 204. Figures Fig. 1 Needs improvements. Add units (mm/yr) to Fig 1b. Make the red circles in Fig. 1b clearer. What aer the thick black line and the yellow line in Fig 1b? What are the white curves in Fig. 1c?

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