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Climate of the Past Discussions

Interactive comment on "Pollen, biomes, forest successions and climate at Lake Barombi Mbo (Cameroon) during the last ca. 33 000 cal yr BP – a numerical approach" *by* J. Lebamba et al.

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- Point 1 The aim of this paper has never been to present "a high quantitative frequency variability of the environment and of the climate at Lake Barombi Mbo during the last 33,000 cal yr BP" according to the temporal resolution of the available pollen data used and published by Maley and Brenac (1998). According the depth-age model of this pollen sequence (Fig. 3 in the manuscript), the temporal resolution of these data is about 200-300 years for the Holocene period and about 500-600 years before. This information, as required by the present referee, will be indicated in the text, in paragraph 2.2.2 (The fossil pollen data). The Barombi Mbo pollen sequence is, as indicated by

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the present referee, an “historic series” and the alone in Central Africa recovering a so long temporal information concerning vegetation and climate at low altitude. In this paper, the challenge was to try a reinterpretation of this sequence in a different and more complete manner than previously made and based on empirical interpretations (Maley and Brenac, 1998), using numerical approaches such as it has been made in other parts of Africa, for example in East Africa. Concerning the “dynamic aspects of the vegetation presented in this paper”, the authors are perfectly aware of the fact that a pioneer stage (that is equivalent to a regrowth stage) cannot remain “static” at a given site during several centuries or several millennia except continual succession of stress. Our reconstructions have never been directly interpreted in these terms. We have always interpreted our data according a combination of scores of different successional stages along the Barombi Mbo sequence, with more or less importance of some of them according the period considered. At any moment, we have interpreted our data considering only the stage with the maximum reconstructed score (as made in numerous works for biome reconstructions, for example in Africa :Jolly et al., 1998; Elenga et al., 2000; Peyron et al., 2006; Hély et al., 2009 for key periods) and so representing pure stand of mature forest or of secondary forest, and even less pure stand of pioneer forest according that this stage is the more unstable and the more rapid to disappear during forest regeneration (see Kahn, 1982). We have only shown that the pioneer stage, as other stages, was more or less developed according the period considered, and can be a good indicator of the disturbance and opening of the forest. - Point 2 When the present referee indicates that “our reconstructions have not be validated against modern data at the core site, the count being available”, the two first authors are very surprised. Indeed: (1) the publication of Farrera (1991) is unknown for us (real publication?; or unpublished report with a limited diffusion ?, and so not available to the African scientific community), and (2) if this reference is related to unpublished Farrera’s thesis (1995), at our knowledge any modern pollen data included in this work (i.e. pollen counts) has been published and/or integrated in a database such as the African Pollen Database (APD). So, these data have never been available

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to the national and international palynological community. Perhaps to individual scientist? But not to the two first authors of this paper, i.e. Lebamba J. and Vincens A. We have tried to have access to these data but with any success. So testing our statistical methods on such a local modern sample was impossible. This explains why the first reference to modern climate reconstruction, based on the top sample of the Barombi Mbo sequence, is not in the conclusion as written by the present referee, but at the end of the discussion concerning the most recent described period (p. 2721 lines 8 and 9). Concerning the sentence "the reliability of the ANN method announced in the abstract seems more than questionable". We have never said that the ANN method was perfectly reliable to reconstruct climatic parameters along the Barombi Mbo sequence. We have only indicated that this method appeared to us the most reliable one compared to the modern analogues technique (MAT) according to the results obtained. In the abstract, the sentence will be rewritten to be more clear to the reader. Moreover, in the section "discussion", our results obtained using the two methods will be discussed, such as a comparison with previous quantitative reconstructions, used methods and interpretations, particularly by Peyron et al. (2006) concerning central Africa at 6000 BP, will be made. "Why such difference in mean annual rainfall (Pann) between 600-700 mm (this paper) and 200 mm (literature), during the LGM?". At our knowledge any quantitative reconstruction of Pann was until today published and so available for the LGM in central Africa. The only reference of such data are included in the Peyron's thesis (1998, p. 98), in a chapter which has never been published. The data indicate, according the methods used: (1) for the classical PFT one, a decrease of 400 mm/yr; (2) using "inverse" method complemented by different concentration of CO2 (modern one and estimated one during the LGM) a changes or Pann from – 200 to + 100 mm. But, we will take into account this question of the present referee and we will try to give a response in the paragraph "Discussion" including a comparison with these data. Yes, the authors suggest that "an improvement of the modern pollen dataset could allow to obtain in the future more reliable quantitative reconstructions of climate parameters in central Africa, but probably also for biome reconstructions". It appears

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clear that the modern dataset available today in central Africa is incomplete to make perfectly reliable vegetation and climate reconstructions, in spite of the numerous new pollen data from low altitude (80 spectra) recently obtained by Lebamba et al. (2009). This paper (mainly under estimated precipitation) clearly indicates that there is a great lack of modern spectra from the most humid forests of central Africa such as those in which Lake Barombi Mbo and its neighboring are today located. The scarce spectra today available in very humid forests are from the Cameroon littoral forest (Lebamba et al., 2009a and b; Vincens, unpublished data but included in our modern database). This paper indicates also a great lack of modern spectra from mid- and high altitude in western Cameroon that has not allowed us to reconstruct realistically the temperature parameter. Only three spectra have been published by Brenac (1988), but detailed pollen counts are not available. This work expects clearly to point out the important problem arising when quantitative reconstructions are proposed, that has not been always the case in earlier publications. The climate reconstructions proposed until today for central Africa have been based on very few modern pollen samples from forests occurring in this part of the African continent (16 samples from Gabon (Jolly et al., 1996); 11 samples (Elenga, 1992, thesis) and 43 samples from Congo (Elenga et al., 2000; data integrated in the dataset used ?). The majority of all the other samples originated from West and East Africa. Moreover, in Africa, any paper have detailed information concerning the content of the modern dataset used and clearly discussed it. In our paper, we used a total of 179 modern forest samples from central Africa (see details in Lebamba et al., 2009b), i.e. a number more than twice that this previously used, and as explained in Lebamba et al. (2009b), some forest spectra, though available, have not been taken into account for vegetation and in this paper climate reconstructions, such as those from edaphic (mainly hygrophilous) forest not in equilibrium with climate. In conclusion, though the modern dataset from central African forested environments has been largely developed during recent time, this work clearly evidence that it is always incomplete to make quantitative past reconstructions such as here proposed at Lake Barombi Mbo, mainly concerning the representation of the most humid forests and mid-

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and high altitude ones. Concerning the “method developed by Kuhl and colleagues in Europe”, because their different modern forest ecosystems and their pollen rain in temperate part of the world are (1) well known and (2) relatively “simple”, that is not the case in central tropical Africa where biodiversity is very high and distribution of plants not always very well known. But we cannot apply this method to pollen taxa which are never represented in the modern pollen data set, such as typical montane forest taxa.values Concerning the “influence of CO2 on vegetation during glacial times”, the work of Peyron’s thesis (1998) in an unpublished chapter (the same that the one cited above) indicates, using the inverse modeling method with CO2 of 340 ppmv and of 200 ppmv, that “ low CO2 concentration does not play an effect on the LGM vegetation in West Africa (i.e. at low altitude according the site used i.e. Barombi Mbo, Bosumtwi and Ngamakala)” (p. 103). All these points are open to discussion. A comparison between our data with those of Peyron, but only concerning key periods such as the 6000 BP (Peyron et al., 2006, mean annual precipitation) and the 18000 BP (mean annual precipitation and index ïĄą, Peyron thesis, unpublished data, 1998) will be made and the results discussed in the corrected paper such as problems of methodology. Finally, it will be indicate in the introduction that the authors use the pollen record published in 1998 by Maley and Brenac (an evidence for the authors in this submitted paper), and the final discussion and conclusions will be rewritten according to the suggestions of all the reviewers. But, confrontation with global or regional climate model simulations is not really the purpose of this paper and we prefer to leave this work to specialists.

Interactive comment on Clim. Past Discuss., 6, 2703, 2010.