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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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General comments As indicated in the reply to L. Dupont referee, concerning the "Result section" (section 4), which has been considered by this referee as "a boring summary of the figures" and by the present H. Hooghiemstra referee as "little informative for the readers", it will be deleted in the final manuscript and replaced by two tables indicating, for each period considered, in the first one the mean and range values of scores of reconstructed biomes and successional stages, and in the second one the mean and range values of the reconstructed climatic parameters. It will be replaced, as suggested by the present referee by a section 4 called "Quantitative environmental

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reconstructions at Lake Barombi Mbo" which will integrate part of our present section 5 but only including our results, their comparison with interpretations given by Maley and Brenac (1998) and other local reconstructions made on the Barombi Mbo site such as biome or climatic reconstructions (for example those of Jolly et al., 1998; Elenga et al., 2000; Peyron et al., 2006). In this way, the future section 5 "discussion" will be focused on more regional aspects, with a comparison between our data and previous empirical and/or quantitative reconstructions in Central Africa and in other parts of Africa such as East Africa (partly made in the present section 4). We have, in the present manuscript, limited the comparison of our reconstructions only with results obtained on the African continent. This paper has not the pretention to synthesize all available data, particularly those obtained off shore in the equatorial Atlantic ocean. In this future section 5 "discussion", we will try also to discuss the methods used in this paper, their reliability in central Africa compared to previous works undertaken in Africa. Moreover, conclusions will be completely rewritten according the restructuration of the manuscript, and we will try that they will be sharper, shorter without repetition compared to other sections, and more to the point. Specific comments (some of them been common with general comments) Some parts of the abstract will be re-formulated, such as in the Introduction ("prediction") as requested by the referee. In this latter section "Introduction", when we write that "numerous quantitative reconstructions..." (page 2706, line 2), it is clear for us that this sentence concerns only East Africa where climatic reconstructions have been made along pollen sequences (e.g. Bonnefille et al., 1990, 1992; Bonnefille and Chalié, 2000 on several sequences from Burundi Highlands. Vincens et al., 1993; Chalié, 1995 at Lake Tanganyika). In central Africa, no equivalent data are today available, neither in West Africa. In this paper, and for the first time in central Africa, we have proposed to quantitatively reconstruct some climatic parameters (Pann, PETann and the bioclimatic index ïĄą), such as vegetation changes, along the continuous Barombi Mbo sequence, an "historic series" as also considered by the anonymous referee, to try to improve previous empirical interpretations made by Maley and Brenac (1998). Environmental setting and data sources Acronyms used in this

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paper do not follow an international literature according to that many authors used their own nomenclature or the nomenclature sometimes previously defined in some parts of the world according the location of their study. In this paper, we used for: (1) our reconstructed climatic parameters, the acronyms used for example by Peyron et al. (1998), i.e. for mean annual rainfall the acronym Pann (more precisely Pann that will be corrected in the final manuscript), and in the same way we have given for potential evapotranspiration the acronym PETann (PETann in the final manuscript). According to that these authors, such as others in European climatic reconstructions or in African ones, used the acronym Tann for mean annual temperature reconstructions any confusion can be made with our acronym MAT (Modern Analogues Technique) used also by Peyron et al. (2006). Meanwhile, it is true that some authors have called mean annual temperature "MAT" and mean annual rainfall "MAP" (e.g. Wu et al., 2007) in their text, but not systematically in their figures. This indicates that no true international nomenclature for acronyms are today available. (2) Our reconstructed biomes, the acronyms follow those defined by Prentice et al. (1992) and by Jolly et al. (1998), Elenga et al. (2000), etc... in Africa. Concerning our reconstructed successional forest stages, the acronyms are those defined for the first time in Africa by Lebamba et al. (2009b). As suggested by the present referee, once an acronym has been introduced in the beginning of the paper, it must be used all over the following manuscript. We will take into account this suggestion in the final manuscript. Concerning the sentence "why mean annual temperature was not reconstructed". During this study, we have, of course, tried to reconstruct also this climatic parameter. The results we obtained were completely aberrant according what is known during the last 33,000 yr BP in Africa and also in other parts of the world. For example, during the Last Glacial Maximum we have reconstructed the highest temperature values along the Barombi Mbo sequence with both modern analogues and artificial neural networks techniques, and during the Holocene period the lowest ones but close to modern values. This feature is linked to the complete lack in the modern dataset here used, such as also in the African Pollen Database, of pollen data from mid- and high altitudes in central Africa.

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Such lack will be fortunately filled in the future thanks to new works actually undertaken in the western highlands of Cameroon in the frame of French programs (CNRS ANR IFORA and C3A). Thereby, any comparison with marine ïĄď18O records are today possible. Methods used in this paper. When the present referee suggests that this paper needs more explanations about the methods used in this paper, we think that a summary of each of them is given in the present manuscript and that references in which these methods are developed and detailed are also given. Results Points one and two indicated by the present reviewer will be corrected or more clearly explained. Vegetation categories. Concerning the 9 (and not 8) vegetation categories defined by Maley and Brenac (1998) compared to our ones. A- Maley and Brenac have defined: (1) pioneer forest taxa (with two sub-categories which are (a) trees and (b) lianas; (2) semi-deciduous forest taxa (without sub-categories); (3) Biafrean and evergreen forest (with three sub-categories (a) trees and (b) lower strata and (c) lianas; (4) Montane forest; (5) Savanna (with only one category "trees"); (6) herbs in forests; (7) herbs in open formations; (8) Aquatic and hygrophilous herbs and (9) Pteridophytes and hepathics. B- In our work we have defined 6 (in fact 7 according that savanna are reconstructed as a biome and also as a successional stage, using different allocation of the taxa to PFTs) categories according our vegetation reconstructions, biomes or successional stages. They are: (1) For biome reconstructions: (a) TRFO (tropical rain forest) corresponding to the category (3) and all its sub-categories, and part of category (6) of Maley and Brenac; (b) TSFO (tropical seasonal forest) corresponding to the category (2) and part of the category (6) of Maley and Brenac; (c) SAVA (savanna) corresponding to categories (5) and (7) of Maley and Brenac. (2) For the vegetation dynamics, only our TFRE (tropical forest regrowth) stage could correspond to the category (1) of Maley and Brenac, such as SAVA to categories (5) and (7). The other stages (TMFO: tropical mature forest; TSFE: tropical secondary forest) include taxa from categories (2), (3), (6). Concerning this latter reconstruction of vegetation changes, the successional stages acronyms used in this paper are those defined by Lebamba et al. (2009b). They are from the youngest to the oldest one: - SAVA: corresponding to grass herba-

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ceous to semi-woody stage; - TRFE: corresponding to the forest woody regrowth stage. In this stage the dominant shrubs and small trees, mainly heliophilous, such as Albizia, Anthocleista, Harungana, Tetrorchidium, Trema and Vernonia conferta are mixed with many coarse herbs (e.g. Zingiberaceae), soft woody shrubs and small climbers (e.g. Dioscorea). - TSFE including (i) sub-stage TYSF: characteristically this young secondary stage is dominated by the fast growing heliophilous Musanga cecropioides which is the most abundant and characteristic secondary forest tree in tropical Africa, associated with Myrianthus, Macaranga or Albizia for the most abundant trees. The herbaceous and shrubby layer is dense and lianas are abundant (e.g. Apocynaceae), and (ii) sub-stage TOSF: this old secondary stage is dominated by semi-heliophilous species of moderately rapid growth. Characteristic species occurring in the canopy are: Alstonia boonei, Canarium, Ceiba pentandra, Zanthoxylum macrophylllum, Pycnanthus angolensis, Terminalia superba, Triplochiton scleroxylon. . .. - TMFO: This is the ultimate stage, or the "climacic" mature stage (Kahn, 1982), of forest, when forest is naturally in equilibrium with local climate. The floristic composition of this forest stage, the presence of shrub and herbaceous strata depends on the status of the forest: semi-deciduous or evergreen one (for this latter one, generally defined by many botanists as semi-evergreen forest according that very few stands of pure evergreen forest occur in Africa). An excellent work on these successional stages was published by Kahn (1982) in Ivory Coast. It is clear that in our present work concerning quantitative vegetation (biomes or successional stages) reconstructions, three vegetation categories defined by Maley and Brenac (1998) have not been considered in our work. They are: - Aquatic and hygrophilous herbs (8). These taxa are mainly representative of local edaphic conditions and not of climate. This category, present all over Africa has always been excluded in previous quantitative biome reconstructions according to their ecological behaviour and often to their low level of identification (e.g. Cyperaceae); - Pteridophytes and hepatics (9). Concerning the Pteridophytes, their level of identification only in terms of "monolete " or "trilete" types in the Barombi Mbo sequence and in many modern spectra, such as their large ecological behaviour, bring us to exclude

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them such as in other works. Hepatics are never considered in the total pollen and spore sums. - The Montane forest (4). We have excluded the two typical taxa of montane forest, Olea and Podocarpus, present in the fossil data but not in the modern ones due to the lack of modern samples from high altitude. According to their abundance in the sequence (mean values of 17% and 3.5% of the total pollen count, respectively during their maximum extension), and to the low and constant reconstructed Warm Temperate Evergreen (WTE) potential biome scores when they were considered in the biomisation procedure (around 5), we made the assumption that these taxa had an allochtonous origin and hence were not representative of the local environment of the Lake Barombi Mbo we want to reconstruct. Other more specific comments such as the technical corrections will be included in the final manuscript. This new manuscript will be corrected by a native English speaker. In conclusion, the present relevant comments and suggestions made by the reviewer will be taken into account to improve the final manuscript.

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