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Climate of the Past Discussions



# *Interactive comment on* "Past environmental and climatic changes during the last 7200 cal yrs BP in Adamawa Plateau (Northern-Cameroun) based on fossil diatoms and sedimentary $^{13}$C isotopic records from Lake Mbalang" *by* V. F. Nguetsop et al.

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Thank you very much for the constructive comments made on our manuscript whose title is given above, submitted for publication to Climate of the Past. However, you raised some important points that need more clarifications.

The point concerning the sand layers at the lowermost part of the core along with phytoliths and spicules has been included in the presentation and interpretations of our

results. Also the curve of the variation of the abundance (%) of Stauroneis phoenicenteron along the core has been included in the data as you suggested (see Figure 5). These data suggest as you said a lowering of lake level between 7400-6000 cal yrs BP but our data did not allowed us to infer absolutely a low lake level. Indeed, modern abundance of tychoplanctonics are observed both in lower lake level occupied by aquatic vegetation and in relative high lake level either in Mbalang modern sediment samples or in other regions of Africa (see for example Gasse, 1986). Moreover, epiphytic and aerophilous diatoms remained consistently low during phase Ia, showing that the lake did not dry and was not occupied by a dense macrophytic vegetation. High abundance of benthic diatoms along with the presence of sand layers suggest a more clearer water column and/or episodic lowering of lake level at seasonal or interannual timescales. The episodic lowering of lake level is also inferred from the ratios Spicules/Diatoms and Phytoliths/Diatoms covarying with higher values of d13C.

The reference to stratification, temperature (cold/warm) was omitted in the revised manuscript as proposed by the referee #2 and yourself. Gasse (1987) considered Aulacoseira distans var. humilis and A. distans var. africana as taxa growing cold stratified water table while studying Sahelian/Saharan waterbodies. As you suggested it these references were not sufficient to confirm this fact; although changing from A distans varieties (Phase I) to A. muzzanensis strongly suggest the variation from stable or less mixed water table to more mixed conditions reflecting probably a seasonality change.

Concerning the interpretations of lake level mixing and inferred rainfall regimes, we try to clarify the information by explaining the displacement of ITCZ and associated weather conditions. These questions also raised by referee #2 and yourself (in Pages 319, 320, 322 CPD manuscript) were explained as follow: In the classical picture of the climate in the region, higher monsoon flux occurred during the boreal summer. During that period of the year, heavy rains directly cool the upper part of the water table reducing temperature differences between the epilimnion and the hypolimnion, and



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finally mixing occurs. The mixing process can be accelerated by monsoon winds. This situation works if one supposes that studied area is included in the convective rainbelt, that is the ITCZ is close to the zone. If we now hypothesise an ITCZ farthest north of the Adamawa plateau, and the convective rain belt being North of the Adamawa plateau, the studied area will be under a climatic zone characterised by a stratiform cloudy weather, low evaporation; rainfall are strongly reduced, precipitation is in form of light rain and drizzle. In these conditions, evaporative heat loss may be suppressed or reduced, surface warming during this period of low winds stress is likely to cause more stability in the water column (Kling, 1987). These conditions can occur today in the Adamawa plateau but are very short in time, but these are clearly observed around the Guinean Golf when the ITCZ is farthest North (July-August) and can explain the bimodal curve of precipitation in some areas (more details in the manuscript).

The question rose in page 321, about "precipitation lower than today in a context of low evaporation": High abundance of Aulacoseira distans var. humilis and A. distans var. africana suggest a stable (or less mixed) water table compared to period with high abundance of A muzzanensis. If one admits that stability of the water table is linked to the farthest North position of the ITCZ, the Adamawa plateau at that time should have had a climate with lower rainfall and low evaporation. In these conditions, lake level could be high even with low rainfall. This can also explain high lake level in a climate with low rainfall in Ossa (page 326 CPD manuscript). Concerning Olea and Podocarpus pollen data, I do accept that their presence was interpreted in this paper as an indicator confirming a cooler climate. Although they could indicate far distant changes, what is sure, is that their ecological niche was closer to the Lake Mbalang environment before 3500 cal yrs BP (indicating a cooler climate) and was reduced or was more distant after that date indicating warmer conditions than before.

13C record: It is possible in theory as explained in the present version of the manuscript that wetland vegetation could influence 13C record but diatom data in the lower part of the core, because of the absence of epiphytic diatoms excluded dense aquatic macro-



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phytic vegetation. The C:N ratios measured from 457 cm to the top shows a decrease from 14 to 10 suggesting that M4 sedimentary carbon has mostly a terrestrial signature corroborated also by data of Ngos and Giresse (in press, the Holocene). The inverse covariations between diatom and carbon isotope data suggested that planktonic and benthic diatoms are not the main sedimentary carbon source (see figure 6). Hence we suggest that carbon stable isotope ratios of M4 core are indicators of vegetation cover of the Mbalang watershed in agreement with sedimentological data.

The discussion section was revised, and more precisions were brought out in order to clarify the information. Some ideas were deleted and information summarized to make it easily understandable. The reason of including Lake Ossa, the Golf of Guinea and Adamawa was to compare the evolution of the climate in lowlands, mid altitude areas and highlands as Bambili. In fact one of the objectives of this paper was to see if the modification of the vertical structure of the atmosphere played an important role in the evolution of the climate in central Africa. Nevertheless we substantially deleted some information about Lake Ossa in order to keep the attention on Lake Mbalang.

The reconstruction of Lake levels, Monsoon flux, and NE trade winds are based on diatom indicators that are Planktonic diatoms, stable water diatoms (Aulacoseira distans var. humilis, A. distans var. africana and Fragilaria delicatissima) and allochtonous diatoms respectively. The curves given in figure 7 are trends and can not indicate absolute values.

Figure 8 became Figure 2

Finally I have to give here the role of the others Co authors: In order to explain the role of each co-author in this manuscript, I should first remained as we said in this manuscript (section Material and methods) that the core M4 was collected in 1998 by Ecofit Program team (M. Servant and S. Servant participated in this mission in Cameroon). At that time I was based in the “Laboratoire de Geologie du Muséum National d’Histoire Naturelle” where I did all the diatoms counts under the supervision



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of S. Servant and first interpretations of the data where done with M. Servant and of course S. Servant. After that I moved to Montpellier since 2009 and continued the writing of the manuscript. But I kept the relation with S and M. Servant who continue helping in reading and interpretation. That is what justifies the presence of these two co-authors. In the “Institut des Sciences de l’évolution (ISEM)” and I added d13C isotopes in the data under the supervision of I Bentaleb and the mass spectrometry technical collaboration of C. Martin. I am not a specialist of stable isotopes, I. Bentaleb wrote and completely interpreted the data of d13C and C:N. That is what justifies their authorship. Charly Favier who is based in ISEM, he read and corrected the different versions of the compiled manuscript. He also has a good understanding of tropical climate and he was useful in replacing data in the regional climatic context.

Thank you again for your helpful comments

Please also note the supplement to this comment:
http://www.clim-past-discuss.net/7/C821/2011/cpd-7-C821-2011-supplement.zip

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Interactive comment on Clim. Past Discuss., 7, 305, 2011.