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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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Concerning the ecology of Aulacoseira distans var. humilis and A. distans var. africana: in the first manuscript we insisted on the fact that the two species were characteristic of cold stratified water table as suggested by Gasse (1987) while studying Sahelian and Saharan waterbodies. Unfortunately these references used were not sufficient to confirm this fact, as you and referee#1 suggested, reference to cold/warm, tempera-

tures changes and stratification were substantially deleted from the present version of the manuscript. Although the changes from A distans varieties (Phase I) to A. muzzanensis strongly suggest the variation from a less mixed water table to more mixed conditions linked probably to a seasonality change.

We precise also the ecology of tychoplanktonics cited in subzone Ia, not all the tychoplanktonics are acidic, oligotrophic and can thrive in "cold stratified conditions", the ones concerned here are Aulacoseira distans var. humilis and A. distans var. Africana, and we later add (zone II) a planktonic taxa Fragilaria delicatissima as an indicator of a stable water conditions. The precisions were made in the revised manuscript.

Concerning carbon isotope data, lake sedimentary organic matter may results from a complex combination of sources: autochtonous organisms (freshwater food chain) and/or allochtonous material (terrestrial riverine and atmospheric inputs). Hence the isotopic composition of the lake bulk matter may reflect a mixture of several sources. The C:N ratios measured from 457 cm to the top shows a decrease from 14 to 10 (see Figure 3) suggesting that M4 sedimentary carbon has mostly a terrestrial signature. For technical problems we did not measure the base C:N ratios but recent paper of Ngos and Giresse (in press, The Holocene) shows that the sedimentary matter of Mbalang lake is mostly terrestrial. 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. Abundance of the tychoplanktonic diatoms shows also an inverse covariation with the d13C. The problem of difference in the sampling interval between diatom and carbon isotope is also solved here by the calculation of mean value (%) of each diatom habitat group and isotope (‰ in each subzone considered.

The diatom data and d13C were also reorganised and the point raised by you presented as follow: Benthic diatoms represented mainly by Stauroneis phoenicenteron, S. anceps var. gracilis and Pinnularia viridiformis are more important in this subphase,

they peaked between 6900 and 6600 cal yrs BP and at 6300-5900 cal yrs BP; their high abundance suggest periods of more clearer water column or at least episodic lowering of lake level. The hypothesis of lake level lowering is also suggested by the presence of sands in the lowermost part of the core along with abundant phytoliths and spicules but the low abundance of epiphytic diatom taxa excluded a very low lake level where the lake basin could have been occupied by dense macrophytic vegetation. The absence of covariation between d13C results and benthic diatoms reinforced the hypothesis of episodic lowering of lake level and the presence or the vicinity of the aquatic vegetation; important terrestrial organic matter input are also suggested by Ngos et al., (2008) and Ngos and Giresse (in press). The differences between wet conditions of Lake Mbalang and the dry conditions in Lake Bambili between 10-7 kyrs BP can be explained while considering the vertical structure of the atmosphere at that time. Highlands of (2200 m) may have been submitted to the influence of dry air masses while relatively middle altitude as Mbalang (1200 m) and lowlands in the Guinean Gulf were under the influence of the stratiform cloud cover due to intense upwellings or more intense monsoon (more details are given in the discussion section). In subzone Ib: The rise in A muzzanensis suggest a generally higher lake level and more mixed water table. This suppose that period of mixing that are now encountered during the boreal summer when NE trade winds are important were longer than before, but the rainfall distribution remained favourable for forest extension/maintenance. One should also note that if our hypothesis of southern shift of the ITCZ during this phase is true, this implies the southern shift of the rain belt and convective area, monsoon winds could at that time be more important and cause more mixing. But this is not contradictory with more intense dry season.

Episode of increased d13C in eutrophic habitats (inferred from diatoms) may be a response to decreasing concentrations of dissolved carbon dioxide due to increased carbon demand during photosynthesis (Hollander and McKenzie, 1991; Law et al., 1995), the presence of 30% of Poaceae taxa (Vincens et al., 2010) may also explain that, the high d13C is from terrestrial origin. This later hypothesis is supported by C:N ratios

higher than 14. In subzone Ic concerning allochtonous diatom taxa; based on their bad state of conservation, their distribution and their abundance in lake modern sediment samples and in the uppermost layer of soils under the forest surrounding Lake Ossa, it was shown that A. granulata var. valida, A. granulata var. tubulosa and Stephanodiscus astraea are originated from the Saharan diatomite deposits (Nguetsop et al., 2004) although they are typical planktonic species. Moreover, recent analysis of modern sediments from a dried wetland (The Ndjombi swamp near Kika in SE Cameroon) revealed the presence of a comparable assemblage of taxa while other diatoms where completely absent. Unfortunately we don't have any other indicators (pollens, dust) that may confirm completely, but the spatial distribution of these taxa in modern sediment in Cameroon reinforced the hypothesis. The winblown diatoms were excluded from the diatom percentage calculations and sum as you suggested. In subzone IIb, it is true that F. delicatissima peaked in only one sample, but it is present all over the second part of the subphase whilst it was completely absent before. We think that it is important information concerning water level and/or stability of the water column. One of the major information is variability of the water conditions shown by the mixture of the different diatom ecological groups in the same sample. Subzone IIc: The precision concerning the substantially decrease of winblown indicating a more stable water column was added in the manuscript.

Discussion

We brought out substantial clarification in this section making it more understandable. Concerning the classical picture of the climate, 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 finally mixing is possible. 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, and rainfall strongly reduced 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 Gulf when the ITCZ farthest North (July-August) and can explain the bimodal curve of precipitation in some areas. It is also obvious that topographically sheltered from the wind and high volume/surface area ration. However, windiness due to monsoon winds, or to NE trade winds as we are suggesting also is likely to mix the water table.

Discussions concerning the termination of the African Humid Period (AHP) were clarified, and we try to summarise some information to facilitate the comprehension, we hope we succeeded in the exercise.

We also tried to correct some of the typos, grammatical changes and problems of figures, but unfortunately we do not have access to the manuscript you corrected during the reviewing process in order to ameliorate these aspects of the manuscript. For example Figure 5 (now figure 7) is correctly labelled. All the data (except in figure 3) are now plotted against the calibrated age given by the age model in figure 4. Correction concerning the expected older age (not younger age) was also done.

Once again thank you very for your contribution in order to improve the quality of this manuscript.

Please also note the supplement to this comment:
http://www.clim-past-discuss.net/7/C831/2011/cpd-7-C831-2011-supplement.zip

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