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Climate of the Past Discussions

Interactive comment on "Palynological evidence for gradual vegetation and climate changes during the "African Humid Period" termination at 13° N from a Mega-Lake Chad sedimentary sequence" *by* P. G. C. Amaral et al.

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RESPONSE TO THE INTERACTIVE COMMENT OF D. VERSCHUREN

First, we would like to thank Dr. Dirk Verschuren for his constructive comments and suggestions that will help us to include new elements in our discussion and so to improve our final manuscript. We are also grateful for the carefully checking typing/editing errors.

GENERAL COMMENTS

The referee points out that our record represents only a short slice of time of the Holocene period and covers very likely only a single part of the AHP termination. We recognized that our formulation might give a misleading impression that it encompasses the entire transition between the AHP and the modern condition. In the final manuscript, we will tune down our formulation and will state that our record "encompasses a part of the mid-Holocene transition".

The referee also underscores some important issues that will need to be better developed in the final version of the text. We agree that, regarding mainly CA1 axis scores, Cyperaceae fluctuations and Pann reconstructions, the period between ca. 6500 and ca. 6100 cal yr BP appears to be the most humid period recorded in the LT1 pollen sequence. But, however, in the lack of older data than ca. 6700 cal yr BP, it seems difficult on the basis of our pollen data to suggest as indicated by the referee that this episode may have been wetter than much of the early Holocene as suggested by some records from the Manga Grasslands (Kajamorum and Kuluwu; Salzmann and Waller, 1998) or at Tilla (Salzmann et al., 2002).

Our sentence "the height and extend of palaeolake Chad very likely remained quite constant and near its maximal Holocene extend" was based on interpretation proposed by Schuster et al. (2005) but, as said by the referee, this is certainly questionable according to our own data. Actually, as suggested by the referee, the fluctuations in Cyperaceae frequencies (Fig. 3), plants that generally grow up around water bodies, can be considered as a marker of the extension or reduction of swampy/marshy environments. The variation of these taxa during the time span covered by our record may suggest that significant elevation and extend of the paleolake Chad occurred between ca. 6700 and ca. 5000 cal yr BP. According our data, the maximum surface area of Lake Chad, during the time period covered by LT1 sequence, should occur between ca. 6500 and ca. 6300 cal yr BP, when Cyperaceae pollen present their minima values (ca. 12%), and a minimum surface area from ca. 5500 cal yr BP onward when Cyperaceae reach their maxima values (ca. 25%). However, the occurrence of Cyperaceae pollen always in lower values (maximum of 27%) than in modern sample JM1 (61.4%), sample collected close to our sequence and considered as the best modern reference, indicates that the lake was always much larger than today. The lake level fluctuations, based on Cyperaceae frequencies variations, follow our Pann estimates and indicate that they are linked to local but also regional climate changes (with more or less river inflow according the period concerned). So, the short moister humid episode between ca. 6500 and ca. 6300 cal yr BP at Lake Chad appears to be superimposed on a long-term mid-Holocene drying trend. Such a feature was also evidenced northward in the Lake Yoa record (Kröpelin et al., 2008a) during the AHP termination, as indicated by the referee, but also more recently southward in the Lake Mbalang record (pollen data: Vincens et al., 2010; diatom data: Nguetsop et al., 2011), and recently with more detail in a high-resolution record from Lake Tizong (Lebamba et al., in preparation) on the Adamawa plateau. On this plateau, these slightly more humid phases have been interpreted either as temporary stable positions of the ITCZ over this region during its southern retreat or to slight northwards shifts, and are in agreement with simulation proposed by Renssen et al. (2003) showing a climate instability during the AHP termination. This discussion will be also included in the final manuscript. However, the referee asked if the changes in sediment composition, i.e. "lithological gradient towards less organic (and more carbonate-rich)" could also confirm changes in the lake surface but, at this stage we do not have this information and so we cannot affirm this hypothesis.

The referee states that it is a big and unjustified leap to suggest that "sedimentation at the location of core LT1 was not affected by variation in the distance of fluvial [pollen] sources during that period", and suggests to the authors to construct a more robust argument to explain why they have privileged a regional vegetation and climate change than the role of rivers (changes in the distance of the deltas and/or of water inflow). More than a distance of the fluvial source, we believed that the variations in water inflow must have mainly affected the LT1 pollen record. We suggest that the distance of LT1 core location to the influence of rivers during the studied period has not plaid

a major role in humid pollen taxa input in the Megalake Chad, because, between ca. 6500 and ca. 6300 cal yr BP, this distance would have been probably greater than before and after this episode. Such interpretation is based on a maximum surface area of the paleolake interpreted according to fluctuations of swamp/marshy Cyperaceae. The highest frequencies of humid pollen taxa contemporaneously observed, mainly in Uapaca pollen, can be supposed to be better linked to increase in river inflow by the major permanent rivers feeding today the Lake Chad (Chari and Logone from the South, Komadugu from the West), but also during the AHP from smaller rivers which were active during the AHP. This could be testified by our interpretation of lake level proposed above, which show that during the maximum surface area of Megalake Chad reconstructed between ca. 6500 and ca. 6300 cal yr BP, the distance of pollen sources was at its maximum, when humid elements, mainly Uapaca, reach their maxima frequencies indicating higher pollen input and far from the delta.

SPECIFIC COMMENTS AND TEXT CORRECTIONS

Abstract

The abstract will be re-written and shortened in the final version of the manuscript. The major comments will be taken into account in this new version.

Introduction

- 3/24, 4/16, 4-25-27, 5/3, 6/1, 6/9: all corrections will be included in the final manuscript.

Study area

- 6/15-16, 6/17, 6/24, 7/1-3: all corrections or complements will be included in the final manuscript.

- 6/24: The Komadugu River drainage basin area is ca. 120,000 km2 (SIEREM database from HSM Laboratory in Montpellier, France; Boyer et al., 2006).

- 7/24: The information is corrected, the mean annual temperature is about 27°C, with mean minima about 20.8°C and mean maxima about 35.8°C (Djamena station: Olivry et al., 1996; database of Climate-Chart.com, last access November/2012).

Material and methods

- 8/15...: The core was collected using a manual Wright piston corer corresponding to a modified Livingstone corer (Wright et al., 1983) operated from an anchored boat. The core after drilling was immediately shipped in France in 12 hours and stored in a cold room at 5°C two days after the drilling. Since we did not used a true sediment-water interface coring technique, we might miss the first centimetres of the sedimentary sequence, which could explain the lack of unsupported 210Pb. We cannot also rule out that present day climatic condition, especially windstorm during the Harmattan season, may cause remobilization and lacustrine erosion and transport of recent sediment. This mechanism may also explain the lack of modern sediment and thus of unsupported 210Pb.

- 8/20, 9/22, 10/10, 11/18: all corrections will be included in the final manuscript.

Results and Interpretation/Discussion

All corrections will be included in the final manuscript.

Conclusion

- 25/22-25: Reference of Holmes (2008) will be integrated in the final manuscript.

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