

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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GENERAL COMMENTS

The paper presents a reconstruction of middle Holocene vegetation at Lake Chad based on a sediment sequence covering a relatively short period of ca. 1700 yrs. The interpretation of fossil spectra is accompanied by a thorough study of modern pollen rain for calibration as well as biomization and quantitative estimate of Holocene mean annual precipitation.

Interactive
Comment

Although presenting only a short pollen sequence, Amaral et al.'s study is an important contribution to a better understanding of the termination of the "African Humid Period". The interpretation of pollen spectra is detailed and based on a profound knowledge of African plant ecology. The only concern I have is related to the quantitative estimates of mean annual precipitation. The estimates are presented with very large error bars resulting in mid Holocene precipitation ranges of 400-1500 mm/a. This precipitation range comprises the present rainfall of multiple West African vegetation zones, including rain forest, savanna and semi-deserts. Given the large uncertainty, does it make sense at all to use absolute rainfall estimates, or should this approach better used for identifying trends only (wetter to drier)?

Estimating rainfall from fossil pollen data in semi-arid and arid regions is strongly hampered by the occurrence of extrazonal vegetation (i.e. vegetation that occurs outside of its main distribution area by occupying habitats with favourable environmental (e.g. edaphic) conditions, such as swamps and lake shores). I do not fully understand from the paper how the authors solved this issue. They mention that swamp taxa have been excluded. Does this include Uapaca, Alchornea and Szygium?

Amaral et al. compare their record with published pollen spectra from the neighbouring Manga Grasslands (e.g. Salzmann & Waller 1998) which also show high Uapaca percentages. Amaral et al. suggest that the Uapaca-rich savannas of Togo might be a potential modern analogue vegetation. In the Manga Grasslands we used multiple pollen records to distinguish between local (lake) and regional (surrounding savannah) vegetation. We could unambiguously identify Uapaca as a swamp forest element and I therefore disagree with this reconstruction of a zonal Uapaca dominated Guinean savannah. At least for the Manga Grasslands, such swamp taxa should not be used for estimating regional rainfall. Please explain why it is assumed that at Lake Chad potential swamp taxa such as Uapaca, Szygium and Alchornea are part of a savanna. Which elements in the Lake Chad pollen profile are representative of a vegetation fringing the large shores and swampy areas of the mega lake? How has the habitat been

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identified?

My concern regarding rainfall estimates from fossil data is an additional comment rather than a major criticism of the general interpretation of pollen data, which I fully support. However I would appreciate if extrazonal vegetation and the inherent problem of estimating rainfall in semi-arid regions could be discussed in more detail.

SPECIFIC COMMENTS

Abstract

Abstract is a bit long and could be shortened. 2322/15: Not sure what “extra-local environment” means. Can it be replaced by “zonal” or “regional”? 2322/28-20: A circular argument: Palynology and reconstructed palaeovegetation has been used to estimate biomes and annual rainfall. Therefore the reconstructed “vegetation distribution” cannot be “supported..by biome reconstructions and mean annual precipitation estimates”, as indicated in the abstract.

Introduction

2323/13: Please delete “ca. 6000-5500 yrs ago” or provide reference, as the termination of the AHP and establishment of the modern hyper-arid Sahara is still under discussion.

2323/22: For African lake data sets please cite:

Hoelzmann, P., D. Jolly, S. P. Harrison, F. Laarif, R. Bonnefille, H.-J. Pachur, and TEMPO (1998), Mid-Holocene land-surface conditions in northern Africa and the Arabian Peninsula: A data set for the analysis of biogeophysical feedbacks in the climate system, *Global Biogeochem. Cycles*, 12(1), 35–51,

Lézine, A.-M., C. Hély, C. Grenier, P. Braconnot, and G. Krinner. 2011. Sahara and Sahel vulnerability to climate changes, lessons from Holocene hydrological data. *Quaternary Science Reviews*.

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3224/8: Please reword “local recycling of precipitation”

2326/2: There are more than four records for the Manga Grasslands, which might be of interest for this paper. See also:

Waller, Martyn P., Street-Perrott, F. Alayne and Wang, Hongya (2007) Holocene vegetation history of the Sahel: pollen, sedimentological and geochemical data from Jikariya Lake, north-eastern Nigeria. *Journal Of Biogeography*, 34(9), pp. 1575-1590

Street-Perrott, FA, Holmes, JA, Waller, MP, Allen, MJ, Barber, NGH, Fothergill, PA, Harkness, DD, Ivanovich, M, Kroon, D and Perrott, RA (2000) Drought and dust deposition in the West African Sahel: A 5500-year record from Kajemarum Oasis, north-eastern Nigeria. *The Holocene*, 10(3), pp. 293-302.

2326/10: The core is not continuous if the upper part is truncated (2329/3).

Material and Methods

2328/19 Please show sedimentology (legend is missing) in Fig.3

2330/17 and 2331/8 There are many trees and shrubs which grow in both wet savannah zones/forests and semi-arid and arid areas with favourable edaphic condition, such as swamps (see “General Comments” on extrazonal vegetation). Please clarify how “non-edaphic pollen taxa” and “swamp trees” have been identified and removed? Did this include *Uapaca* and *Syzygium*?

Results

2332/27 Please provide in addition to the summary pollen diagram the full pollen record with all taxa; either in the main text or supplement.

2333/4 Fig 5 would be easier to read if latitudes were indicated for each site.

Interpretation and Discussion

2340 4-8 Please reword, as the sentence is not in line with the authors interpretation

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(see Salzmann and Waller, 1998). Instead we showed with our multiple pollen records that *Uapaca* migrated into the Sahel and was present in the Manga Grassland AND colonised the dune depression. The occurrence of *Uapaca* is not an either/or question as suggested in this manuscript.

2341/19 A Holocene “Guineo-Congolian lowland rain forest” at Lake Tilla is a (re-)interpretation which is not supported by Salzmann et al. 2002. Please delete.

2343/16 long distance transport instead of “extra-regional” ?

2343/16 see also Waller et al. 2007

Conclusions

2346/17-19 Circular argument (see abstract)

TECHNICAL CORRECTIONS

Check abbreviations for yr and yrs

2323/23 Kuper et Kropelin

3224/20 Regardless. . .

2328/5-6 Too many full stops

2334/3 “older/younger than” instead of “after”

2337/9 Grammar error

2341/12 Schulz instead of Shlulz (also check typo in respective reference “Hydrobiologia”)

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