

## General Comments

The paper by Bouimetarhan et al. documents vegetation changes in the catchment of the Rufiji river in southern Tanzania based on a marine sediment core just off the coast. The study region 5-10° south of the equator is a very interesting study site as it appears to be located at the transition between south African and the sub-Saharan climate and it records also both continental and marine processes, which makes it a very valuable record. The data set is covering the very interesting time period (19.2 - 10.2 ka BP) of the transition from a dry East Africa during the LGM to the African humid period (AHP, ~15 - 5 ka BP). The findings of this study are of broader interest since pollen records from East Africa are rare but extremely important to understand the response of the ecosystems to climate variability in this climatically highly complex region. The most advantage of the study in my eyes is the reconstruction of the response of the coastal vegetation to the sea level rise during the deglaciation period.

Despite this interesting topic, the manuscript has some difficult parts that need some modifications. In particular, the paleoclimatic implications within the manuscript are yet not convincing. In particular, climatic systems today and for the studied time period are not well explained or incomplete and it feels that the authors discuss the different possibilities not objectively enough. I suggest for the manuscript to adjust the parts about the palaeoclimate implications.

Please find also specific and technical comments in the attached document.

## Specific Comments

1. Page 3932 - Line 14 to 17:

The shift of the ITCZ as the explanation of past vegetation changes in the study area is not convincingly explained in the discussion. I suggest to adjust this sentence here as suggested further below. Also, the authors write that there was a return of humid conditions after the H1 implying that tropical East Africa was wet before the H1 as well, which was not.

2. Page 3933 - Line 13:

I would add here "eastern" or "south-eastern" instead of just saying "southern" since this study is about (South-) East Africa and the authors also refer later in the article just to eastern Africa or tropical Africa. I suggest to stick with one word explaining your study region - either tropical East Africa or tropical Southeast Africa.

3. Page 3933 - Line 0 - 24:

The introduction into the state-of-the-art about paleo-climatic knowledge of the region is very confusing. The authors jump from Northwest Africa to the southern tropics and then to East Africa and also between modern short-term and millennial scale influences. I suggest to structure the introduction better for consistency with explaining how the climate in tropical East Africa is believed to have been during the last 20,000 years, what are the existing views about forcing mechanisms for long-term humidity changes in East and Southeast Africa, and those responsible for millennial and centennial scale climate variability (and maybe inter-annual) in that region and what are the current debates. The study area is a very interesting and a highly debated region as it seems to be located in a climatic transition zone as proxy sites and modelling studies have shown over the past 15 years.

4. Page 3933 - Line 18 - 20:

The word 'reduction' should be better changed into 'variability' since ENSO (El Niño and La Niña) influences different regions of East Africa differently (e.g., Nicholson, 1996; Segele et al., 2009; Wolff et al., 2011).

5. Page 3934 - Line 4 - 9:

These 3 sentences are confusing. While the authors explain in the first sentences that existing pollen records from East Africa do correlate with climatic perturbations in the North-Atlantic, they mention in the third sentence, that abrupt changes are not clear to what they react as they vary geographically. Which time are the authors in the first sentences are talking about and also which locality are they referring to? And what do they mean with the sentence about abrupt changes? Do they mean millennial scale or centennial scale climate variability in tropical East Africa? Maybe just use instead of 'abrupt' here again the term of short-term climatic fluctuations (millennial or centennial scale).

The authors claim also that there is no clue about what climatic pattern influences millennial to centennial-scale climate variability in East Africa. There are various publications about the last 30,000 years in East Africa suggesting most likely scenarios (e.g., Gasse, 2000; Barker et al., 2004; Gasse et al., 2008; Foerster et al., 2012; Costa et al., 2014; Junginger et al., 2014). Or do the authors mean only the tropical southeast African region?

6. Page 3934 - Line 16 - 25:

I wonder whether these sentences are necessary to remain here as these occur in the abstract and also in the conclusion. In my opinion, the introduction should introduce the reader into the topic and a short information about how this new study will contribute to the current debates. Results and interpretation may not be placed here?

7. Page 3935 - Line 4 - 5 / Figure 1:

A notification that this chapter is explaining figure 1 is missing here. Also, the catchment of the Rufiji river is explained to lie entirely in Tanzania, and this is what I found in the literature, too, but in figure 1A, the outline of the catchment extends far beyond the Tanzanian borders and makes no sense at all as the tributaries of the Rufiji river end also in Tanzania. I assume that this is just a drawing or export problem while producing the figure?

8. Page 3935 - Line 24:

What do the authors mean with "environmental gradients"?

9. Page 3936 - Line 17:

What temporal resolution is meant with high resolution?

10. Page 3936 - Line 20 - 24:

That is convincing!

11. Page 3937 - Line 22 - 23:

Would it be possible to add a short explanation why only Al and Ca were chosen for the study and what the Al/Ca ratio is standing for?

12. Page 3939 - Line 1 - 2:

Is there an explanation why the authors think the pollen concentration is too low in the upper parts of the record, which have been excluded from the study?

13. Page 3939 - Line 8 - 12:

I see only comparatively high values in the pollen concentrations around 19.2, 14.8 and shortly after as well as around 12 ka BP. Couldn't it be that the sudden increase in pollen concentrations at 14.8 and 12 ka BP may be related to the onset of the African Humid Period after the LGM drought period with higher rainfall causing enhanced erosion of sediment containing pollen from the catchment during the initial runoff? The pollen concentration in the rest of the time fluctuates between 40 and 15 grains cm<sup>-3</sup> over the entire studied period. Fluctuations seem to increase toward younger times but this might be due to the higher sampling resolution in the upper parts of the record? I also do not see a very good correlation of high freshwater algae content and Al/Ca maxima.

14. Page 3940 - 3941:

The chapter about the dynamics of the lowland vegetation is convincingly explained. I am wondering whether the authors have an idea why or if there is a slight decline in the mangrove communities shown in the record after 11.5 ka BP?

15. Page 3943: Line 3:

I do not see a gradual decline in the afro-montane taxa between 16.6 - 14.8 ka. I rather see a collapse of the taxa at 16.8 and 15.4 ka BP with a simultaneous increase in dry wood and shrubs and a kind of gradual decline after 14.8 ka.

16. Page 3944: Line 8: The mentioned lowered lake levels in the cited literature were not also lowered during the H1, those have been low before as well, compared to the time after 14.8 ka. I think this is an important fact that has not been mentioned at all in this manuscript. It always feels like tropical East Africa has been wet before the H1 as well, which was not according to various publications.

17. Page 3944: Line 23:

Instead of saying just 'changes' I suggest to clarify that an "increase in humidity" is meant here.

18. Page 3944: Line 24:

All the cited publications present data sets from NW Africa. It would be better to indicate that more clearly than just writing northern Africa.

19. Page 3945: Line 16 - 18:

This sentence interrupts the discussion about the north-south anti-phase relation in African precipitation. Since you already started the discussion about ENSO on longer timescales before (see your discussion in line 7-10), you could add this sentence right after this statement and follow then with the discussion about the H1 experiments etc.

20. Page 3945: Line 20 - Page 3946 Line 3:

It was difficult to understand the mechanisms that the authors summarise here. I have the feeling some important information is missing or is too little explained. For example: Line 28-3: I agree that shifts of atmospheric systems are physically possible and have been shown by various studies. My knowledge of atmospheric processes is restricted and I am happy to be corrected, but the shift of the ITCZ more to the south of East Africa does not explain to me, why it is dry in the Rufiji area during this time. The region of subsidence and ascendance and thus the location of the ITCZ over East Africa is dependent on the local insolation maximum which in turn is dependent on the month of the year. The ITCZ migrates over the year between its northern and southern limits (~10°N-10°S) and crosses in my opinion always the equator and thus producing the regular rainy seasons (e.g., Nicholson, 1996). A shift of the ITCZ further to the south might be of major interest for sites that usually are not reached by it? I am happy to be corrected when I am totally wrong, but dry periods in the study region should thus be caused by reduced rainfall amounts during the rainy seasons. Maybe the authors just forgot the word 'mean' annual position of the ITCZ, as it is used in the climate models such as by Mohtadi et al. (2014)? The mechanism behind, such as moisture export, SST changes, weakening of the monsoon strengths etc. as Mohtadi et al. (2014) also concluded should be noted here as well, as this is a whole coupled system and not just referring to a shift of the ITCZ further south.

21. Page 3946 Line 16 - 3947 Line 4 - 17 - YD Discussion: I am wondering whether the higher sampling resolution during the YD time interval might be responsible that larger fluctuations are observed compared to the H1 interval?

22. In general, I am wondering why there is a detailed discussion about Hadley Cell displacements for drought periods in the study region with focus on the NH influences, but there is no explanation,

why East Africa became wet although the NH was still cold and dry. A few sentences about this important transition might provide the base to strengthen the discussion.

23. Conclusion chapter

If the authors agree with the comments above, the conclusion should be changed accordingly. In particular between line 19-26, where they state that only due to a shift of the ITCZ southward, millennial scale droughts in the Rufiji catchment were caused. This alone is not plausible to me.

24. Figure 1

The catchment of the Rufiji River seems to be wrong in this figure. It is explained as a basin that lies entirely in Tanzania. But the shape of the catchment extends far beyond the Tanzanian boundaries. It makes also no sense that it extends as far west and south beyond Lake Tanganyika and Malawi as it is shown in this figure. I assume that this is just a drawing or export problem while producing the figure?

Additionally, it would be nice for the reader to see at least the southernmost position of the present ITCZ (and maybe also for H1), Condo Air Boundary and wind directions for the rainy season in the study region.

25. Figure 5

What are the dashed lines are for? They do not mark the YD and H1, as they did in the other pictures. A sentence in the figure caption would be good.

26. Figure 6

This figure is a bit confusing because only forest and humid woodland and dry woods and shrubs are chosen to be excluded from the dominant pollen taxa. While the authors discuss the pollen communities in figure 6a-6e in chapter 5, the discussion in chapter 6 is about figure 6f-6h. I do not see a big advantage in displaying just the selection of the green and orange curves.

### **Technical Comments**

27. Page 3939 - Line 7:

The notification about figure 3 is not necessary here, because it occurs already in the previous sentence.

28. Additional figure suggestion: A figure showing a compilation of cited proxy data sites for the studied time period would be helpful to better follow the discussion about the paleoclimatic implications.