

Interactive comment on “Linking catchment hydrology and ocean circulation in Late Holocene southernmost Africa” by Annette Hahn et al.

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The study encompasses an impressive variety of methodologies and of different proxies, and discusses the rich results in a convincing way, especially for what regards the aridity-humidity multi-proxy reconstruction. An undoubtable strength of the approach is the analysis carried out in samples from several places in the Gouritz catchment, which provides decisive supports for the inferences made. I would recommend that the manuscript be published, although prior to that the authors should improve a few aspects of it, and respond to some questions that I detail below. Thank you to the reviewer for the helpful comments on this manuscript! We have tried to include the helpful comments of the reviewer in the modified manuscript (for the moment only the modified figures could be attached). General reservations that I have with this work are: 1) a better effort could be made of emphasizing, especially in the abstract

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and introduction (and potentially also in the title), what the key findings are and what their importance implications of their results is. We have added the implications of the key findings at the end of the abstract. We have modified the introduction as well, but we thought it best fit to stress the implications of the key findings mainly in the abstract. As it is it resembles more an account of analyses carried out in a very good setting (whose importance could be made even more clear). We have added the following to the beginning of the abstract: “In addition to this, it’s location at the interface of Atlantic and Indian Ocean circulation systems makes the southernmost tip of South Africa a climatically extremely sensitive as well as interesting area. Thus far few marine records have been available in order to study the interplay of marine and atmospheric circulation systems. This study of sediment core GeoB18308-1 at the terrestrial-marine interface fills this gap for the time interval of ~4 ka BP.” 2) It would be very interesting if the authors could draw more explicitly the implications of their results, and/or of the conceptual model they somehow validate, To explain better what we mean by validate we have added: “The only SST record published for the area (Cohen and Tyson, 1995) does not include data for the time frame in question.”” The decrease in SSTs recorded in GeoB18308-1 for the interval of increased humidity in the Gouritz River catchment inferred in this study for the time interval of the Medieval Climate Anomaly serves as data to validate the conceptual model by Cohen and Tyson, (1995) for which thus far no Medieval Climate Anomaly data had been available.” for the latitudinal shifts in ITCZ. This is of interest to a larger climatological community, and to projections of what the region may expect with ongoing climate change. We did not want to include an attempt to make a predictions of future climate that are too speculative. We have however added a suggestion of a future prognosis at the end of the abstract to address this reviewer comment. 3) the paper is very wordy, especially in its sections 2 to 5. The authors should improve readability and really consider refraining from reporting all they have done and all results, and focus of what is of relevance to the new findings discussed. Some records barely matter for the discussion. We have tried to shorten the complete regional settings section (2) as

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well as the methods (3) and results (4) to a minimum in particular for the not much used heavy mineral and microfossil proxies. Furthermore we have rewritten large parts of section 5 in order to make it more readable (even if maybe not shorter) 4) Probably because of the vast amount of material presented, the manuscript is sloppy in many parts: odd sentences, mismatches in the wording, punctuation, typos. One would expect that nine authors could proofread the manuscript to a higher quality. We have reworked the manuscript to fix this. Main specific points The first sentence of the introduction seems inconsequential and unjustified to me: there is no argument for the importance of South Africa's geographic position. Re- phrase. We have rephrased the first sentence to make this clearer. I would suggest to pay more attention to streamlining the introduction chapter: as it is it is hard to read, and the main points that the authors wish to make do not come through clearly. What are the main research gaps regarding South African climate? Can you present the evidence for one or the other explanation in a more organized manner? We have removed some of the surplus information and focused the introduction on the 2 main research questions of the region. I would recommend an effort to focus section 2. It could be made more concise, and thus the readability of the paper could improve, if you privilege the information that is relevant to the findings of this paper. E.g., the reader doesn't gain insight that are relevant to this Late Holocene paper by your discussing Cretaceous tectonics. We have removed some of the surplus information, the section now only includes what is relevant for the interpretation of the data. Fig 4. The LIA follows the MCA, not the other way around. Changed Pag 14 line 2 and following. First, from fig 5 one would say that all discussed changes happen from ca. 950 yBP, rather than 1150. Can you clarify whether the figure or the discussion are correct? The figure is correct I have changed the text Further, I don't think you can state that anything happens to the SST record around 1150 yBP, at least from the results contained in fig.5. Simply the sampling temporal resolution increases, but I would argue there is no real difference in variability before and after 1150 kBP. If anything, low peaks appear after that time: could you show a real statistical significance between the average SSTs either side of

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1150kBP? None of the SSTs inferred for the period before the MCA are lower than the average SSTs measured for the MCA interval (n=17). However, we will remove all mention of a difference in variability, this may indeed be an artefact of the sampling resolution as the reviewer suggest. . . (related to one of the main objections of reviewer 1) You state that age-reversals occur from 650 yBP, but from figure 5 one can see that you take data up to ca. 500 yBP seriously (also the gray band starts at 500): can you clarify? Sorry, there is a mistake in the caption of Figure 4: the reworked package is at 26-69 cm depth and (not 66cm)! The 1294 cal. Age BP age at core depth 69 cm, was removed from the age model as part of the redeposited package. Pag 14 ll 27-28. For intensification of Agulhas Current transport, you should check Durgadoo et al (2013), who report, from three ocean models, that northward shifts (and intensification) in atmospheric features increase Agulhas Current transport contrary to what included in the conceptual model here discussed. This does not mean that ocean models in the above studies hold the truth, but I would suggest you could take the occasion to discuss this contradiction in the literature. (also in the Conclusions) Pag 16 line 10. Future climate change may follow what pattern? You reported two. We have removed the LIA scenario so it is hopefully clear now that we are referring to the MCA scenario. Also, could you provide a reference supporting this? (rephrase anyway, as sentence is confused) Unfortunately not, this is our suggestion. . . Minor comments: The title could be modified to eliminate the present continuous tense – vague – and include any word that reports the results of this “linking” New title: Southerly anticyclonic circulation drives climatic conditions and sea surface temperatures in southernmost Africa Abstract: “highly dynamic” and “highly complex” used just one sentence apart, maybe either make more specific or eliminated one Done “give information on climatic changes”: it is vague, make more concrete. Oceanographic and hydrologic changes in specific The last sentence is unclear: to which processes do you refer, to those in the LIA or in the MCA? Rephrase. Also, probably not appropriate to only refer to a climate model like this at the end of the abstract, where the reader cannot make much out of it: essential information is missing. We have changed the abstract accordingly

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LI 9-12. This sentence is complicated and doesn't show a contrast between concepts that one would expect from the use of "while". LI 16 ITCZ not explained, maybe avoid abbreviation as never used anymore. Written out LI 16-18 you either use whether, or add a question mark, not both. Question mark removed Page 3 line 4. Durgadoo et al 2013 find precisely the opposite, i.e. that Agulhas leakage increases when westerlies move north. I would suggest you deal with this in the introduction. As also suggested by referee1 the citation was removed line 6. What is YRZ? Written out in text LI 16-17. Odd phrasing, a sediment core doesn't aim to anything. Rephrased to "our work" aims Line 28. Harmonize the units (use exponential in place of Mm3) Done Line 32. What do you mean by mixed summer and winter rainfall? And why this single paleo piece of information in a present-day context? Removed Page 6 ll 15-16. Sentence not clear: what is the unit for the numbers in parenthesis, years? (14C should have 14 in the superscript) Dewar et al 2012 is missing from the ref list. Unit and reference added Line 17. Why do you inform about the sedimentation rate: this is not further discussed in the paper. Removed Line 21. Analyses. Line 24. Change "elemental profiles" in place of "scanning data". Done Line 27. Change "vertical resolution or downcore resolution" in place of depth resolution. Done What are 1.2 cm2? Removed Line 3. Change "scanning intensities" for a more appropriate term Changed to peak intergals Pag 7 ll 4-5. Not clear how the xrf data helped in selecting the samples for organic geochemistry, please reformulate. Reformulated – a higher resolution is chosen in the upper part. ... Methods: try to avoid so many abbreviations, especially those not further used in the paper. In general the manuscript is highly packed with abbreviations, please try to be parsimonious with them. We tried to stil to this advice throughout the manuscript Pag 9 line 16. "micropaleontologically" probably not a word. Changed to microfossil analysis Pag 10 line 2. "None of the considered taxa was found to correlate". Added Line 4. What do you mean by point counted? Point counted is a method used instead of grain counting of minerals in order to do justice to the larger size of some minerals – Because some researchers are probably not truly informed about this fundamental technique, we have changed the text... As you can see just

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few rows after it is explained the importance of this method. ... I can also suggest to have a look at this nice paper of a colleague of mine for a wider application to your specific studies. Garzanti Eduardo 2016. From static to dynamic provenance analysis – Sedimentary petrology upgraded. *Sedimentary Geology* 336, 3–13. He writes at page 5/11: "Point-counting techniques are highly recommended for heavy-mineral analyses carried out on bulk-samples or wide grain-size windows. This is because the discrepancy between the real volume percentages and the number percentages as determined by grain counting increases with the increasing width of the grain-size window analyzed, and volume percentages are systematically overestimated for denser minerals that are smaller than settling-equivalent lower-density minerals (Galehouse, 1971)." This reference is already included in the manuscript: Galehouse, J.S., 1971. Point counting. In: Carver, R.E. (Ed.), *Procedures in sedimentary petrology*. Wiley, New York, pp. 385–407. Line 15. Same reference occurs twice. Removed Line 20. Fig S4 does not exist. S3 Pag 14 ll 15-17. The reader gets the impression that the MCA is a Southern African phenomenon, while this is a concept normally applied north Atlantic records. Please rephrase. Also, punctuation is jumbled. We have clarified that this is a NH trend expressed in South Africa. ... Line 30. "serves as data to validate", not really clear, could you reformulate? Rephrased: The decrease in SSTs recorded in GeoB18308-1 for the interval of increased humidity in the Gouritz River catchment inferred in this study for the time interval of the Medieval Climate Anomaly serves as data to validate the conceptual model by Cohen and Tyson, (1995) for which thus far no Medieval Climate Anomaly data had been available. Pag 15 line 19. An anthropogenic signal shouldn't be expected only for the recent decades, as humans and colonization of South Africa were active (and potentially modifying the vegetation) also during the LIA, please check/reformulate. We see no evidence of anthropogenic impact so I have removed this entirely Conclusions: please reconsider the use of resounding wording like "unique" (twice; surely this is not the only record to report SSTs along with terrestrial proxies), "not only" removed / changed to "advantage" Caption Fig. 4. Explain what the 10,000 iterations are. Caption modified: the calibrated 14C dates

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(transparent blue) and the age-depth model (darker greys indicate more likely calendar ages; grey stippled lines show 95% confidence intervals; red curve shows single 'best' model based on the weighted mean age for each depth). Also, please turn the numbers of the y-axis by 180 degrees Done Fig 5. Why no LIA grey block until the right part of the figure? It seem that the last curve to the right extends into the future. MCA and LIA colour references in the caption are wrong. Also, you plot PCA but refer in the text to PC1. In general, check the wording and concordance between caption, figure and what reported in the main text, as there are several mismatches. Since there are many proxies, you should avoid confusing the reader with slightly different wordings. We have tried to pay attention to this changing Fig. 4 and 5 Fig. S2 contains mistakes: commas instead of points, no units for temperatures, BIT-index instead of BIT. We have modified the Fig S2 accordingly.

Please also note the supplement to this comment:

<http://www.clim-past-discuss.net/cp-2016-100/cp-2016-100-AC2-supplement.pdf>

Interactive comment on Clim. Past Discuss., doi:10.5194/cp-2016-100, 2016.

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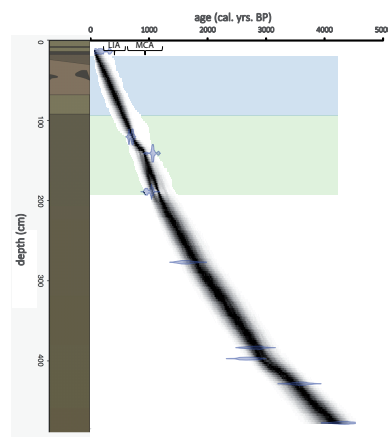


Fig. 1.

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