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Interactive comment on "Global and regional sea surface temperature trends during Marine Isotope Stage 11" *by* Y. Milker et al.

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We thank the referees for their constructive and relevant comments, which touch several critical issues of the paper. We believe we are able to address these concerns effectively and outline below in detail how this can be done. As a result of these comments, the revised version of the paper now includes a more thorough consideration of proxy uncertainties, which resulted in two additional graphs and analyses presented in the supplementary information. We have also considered more carefully aspects of the proxy-model comparison, especially the robustness of the comparison of anomalies.

The response to the individual comments by both referees is given below, highlighting the original comments, which are followed by the response.

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Interactive Discussion

Discussion Paper

Comments by referee #1 (Antje Voelker)

"My biggest issue with the paper is related to the chronostratigraphy. On page 842 the authors write that records were tuned to LR04. The compilation includes records from 14 cores/ Sites records (DSDP 607, GeoB1312, ODP Sites 722, 806, 846, 980, 982, 1012, 1020, 1089, 1090, 1123, 1143, and 1146) whose benthic isotope records are part of LR04. One of those Site is ODP Site 1020 were a correlation to LR04 is shown in Figure 2. So my question is were all those records correlated back to LR04? Why? Are there major age differences between the Lisiecki and Raymo ages and the new correlation? The LR04 ages for the respective records are now available from http://lorraine-lisiecki.com/stack.html."

This comment is based on a misunderstanding of the methods section, which we will modify to make it clear how exactly the age models for each core have been derived. The LR04 stack has been used as the common target for age model construction for all records to assure internal consistency. We have not changed or retuned any ages in this stack, only assigned ages to records on the basis of stable isotope curve correlation with LR04. The referee is right to ask how we have proceeded with the 14 records that were included in the LR04 stack. In this case, we have not retuned the records to the LR04 stack. Instead, we have identified a limited number of age control points in these records depending on their resolution such that the number and type of control points was comparable to the other records and then used the age and depth assignment of these points based on the original LR04 age model for each core.

"p. 841 –Material: there are two, potentially even three additional records that could be included into the compilation whereby the two MD96 cores are relevant for the South-eastern Atlantic. All cores should be conform with the temporal resolution criteria. The cores/ Site are: 1) MD96-2085 by Chen et al. 2002, Late Quaternary sea-surface temperature variations in the southeast Atlantic: a planktic foraminifer faunal record of the past 600 000 years (IMAGES II MD962085): Marine Geology, v. 180, p. 163-181. 2) MD96-2081 which has planktic foraminifer faunal data but no SST calculated by

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Peeters et al. 2004, Vigorous exchange between the Indian and Atlantic oceans at the end of the past five glacial periods: Nature, v. 430, no. 7000, p. 661-665. 3) IODP Site U1314 by Alonso-Garcia, M., Sierro, F. J., and Flores, J. A., 2011, Arctic front shifts in the subpolar North Atlantic during the Mid-Pleistocene (800-400 ka) and their implications for ocean circulation: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 311, no. 3-4, p. 268-280. And Alonso-Garcia et al. 2011, Ocean circulation, ice sheet growth and interhemispheric coupling of millennial climate variability during the mid-Pleistocene (ca 800-400 ka): Quaternary Science Reviews, v. 30, no. 23-24, p. 3234-3247."

The data from core MD96-2085 are included into the compilation. Although the other suggested cores/ sites provide high resolution isotope records and/or SST records, we cannot include these records into the compilation. For MD96-2081 no SST data are available, which means it could not have been included in the analysis. The SST record of IODP Site U1314 is only available for the early MIS11 (from 400 ka and older) and so does not cover the entire interval we have chosen. Therefore, this core cannot be included into the compilation.

"p. 844 bottom: 394 ka is _ equivalent with isotopic event 11.24 (and an IRD peak at Site U1313 –see Stein et al. 2009 or Voelker et al., 2010) and thus not interglacial MIS 11.3 anymore. So correct to MIS 11 in the last line and likewise in p. 846 line 5."

Correction according the reviewer suggestions have been made on the text.

"p. 849 line 25 and following text and Table 1: the correct nomenclature is ODP Site 999, IODP Site U1313 etc. – that is the word "Site" is missing. By IODP rules Site is capitalized."

The term "Site" has been added.

"p. 850 line 2: insert "mid-latitude" before North Atlantic because there are many more sites/ cores in the North Atlantic that do not show this signal."

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The term “mid-latitude” has been added.

“p. 852 line 5-9: The model seems not to capture the strengthening of the Agulhas retroflection that is clearly depicted in the two MD96 cores mentioned above (Chen et al., 2002, Peeters et al., 2004). Peeters et al. 2004 also see enhanced Agulhas leakage during the “394 ka” time slice. So the data from these two cores supports the evidence from ODP Site 1085.”

At least qualitatively, the reconstructed SST trends in the Southeastern Atlantic are captured by the model relatively well (Fig. 6). We would also kindly like to point out, that the data by Peeters et al. (2004) show relatively low percentages of Agulhas leakage fauna at 394 ka (their Fig. 3b). Moreover, at the same time, the data by Peeters et al. suggest a southern position of the subtropical front/convergence (their Fig. 3c), which would be inconsistent with a Sverdrup-balanced flow. We acknowledge, however, that Agulhas leakage and retroflection involves non-linear, meso-scale dynamics (Agulhas rings, inertia, etc.) which is neither captured by Sverdrup dynamics nor by a relatively coarse-resolution global climate model like CCSM3. Therefore, we refrained from any further analysis of this regional system based on the CCSM3 output.

“p. 854 line 7: replace Hole with Site”

Done.

“P. 855 line 18 and following: Do the Lake Baikal (e.g. Prokopenko, A. A., Hinnov, L. A., Williams, D. F., and Kuzmin, M. I., 2006, Orbital forcing of continental climate during the Pleistocene: a complete astronomically tuned climatic record from Lake Baikal, SE Siberia: Quaternary Science Reviews, v. 25, no. 23-24, p. 3431-3457 or Prokopenko, A. A., Bezrukova, E. V., Khursevich, G. K., Solotchina, E. P., Kuzmin, M. I., and Tarasov, P. E., 2010, Climate in continental interior Asia during the longest interglacial of the past 500 000 years: the new MIS 11 records from Lake Baikal, SE Siberia: Clim. Past, v. 6, no. 1, p. 31-48.) or lake El’gygytgyn records (D’Anjou, R. M., Wei, J. H., Castañeda, I. S., Brigham-Grette, J., Petsch, S. T., and Finkelstein, D.

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B.: High-latitude environmental change during MIS 9 and 11: biogeochemical evidence from Lake El'gygytgyn, Far East Russia, Clim. Past, 9, 567-581, doi:10.5194/cp-9-567-2013, 2013.) show the same?"

We have compared these records with the observed lengths of the warm interglacial conditions given by EOF2 and conclude that these records are not in clear accordance with our reconstructions. Consequently, we have adjusted the relating text passage in the manuscript.

"Caption of Figure 7: I suggest adding a note in the different y-axis scales."

A note to the different axes scaling has been included to the figure caption.

Interactive comment on Clim. Past Discuss., 9, 837, 2013.