

Interactive comment on “Marine sediment records as indicator for the changes in Holocene Saharan landscape: simulating the dust cycle” by S. Egerer et al.

Anonymous Referee #3

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Review of "Marine sediment records as indicator for the changes in the Holocene Saharan landscape: simulating the dust cycle"; bei Egerer et al.

This manuscript describes a dust model study comparing 0K and 6K dust emission and deposition fluxes that was performed with the global aerosol-climate model ECHAM6-HAM2.1. The aim of the study is to determine the controls of the dust cycle by the different surface conditions that occurred under preindustrial conditions compared to conditions at 6K, when the dust deposition was reduced likely due to increased vegetation cover in in the Sahara desert and thus reduced dust sources. So far there are only a few model studies on the dust cycle at 6K, and this paper provides an additional

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aspect by comparing the roles of the effects of increased vegetation cover and higher lake levels in northern Africa, respectively. This is an interesting aspect. However, before publication the manuscript requires some revisions.

Major comments:

The description of the model setup is very short, and the paper remains unclear in describing details of the work. The following aspects require more description and discussion:

(1) As far as it can be understood from the paper the vegetation reconstruction for 6K conditions (shown in Figure 1) is based on a reconstruction by pollen data that was published in 1998. As can be seen in the figure this reconstruction provides only a crude vegetation pattern with constant vegetation cover for different longitudinal bands. That is certainly based on the fact that the data availability is limited in this region. It is not entirely clear if the vegetation cover at 0K is computed using the vegetation model JSBACH? If that is the case, then it should be clearly explained why the vegetation cover at 6K is not also simulated by JSBACH, which would have provided more spatial detail. If JSBACH is unable to provide a reasonable vegetation reconstruction at 6K, then why use it for 0K? This should be clarified. In Figure 1 the fractional vegetation cover for the 6K conditions according to the colour scale is more than 0.5 for most of the Sahara. In fact this dense vegetation cover should inhibit the dust emission completely, but apparently this is not the case in the model. Please explain. Apart from the fractional vegetation cover, which vegetation type is assumed for 6K vegetation cover in the Sahara?

(2) For the differences in lake levels for the different simulation it is unclear on what data the 6K lake distributions are based. Are the extents of the lake levels at 6K taken from a reconstruction or do they only represent the maximum possible lake extent based on the distribution of enclosed topographic depressions as indicated in the lowest right figure? This should also be made clear in the text. The resulting differences

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in dust emissions may be biased by the fact that the ECHAM-HAM model assumes all topographic depressions as preferential sources. However, this underestimates the potential importance of alluvial dust sources, which are probably important dust sources in the Sahara and may be unaffected by lake level changes. The lake sediment source type should be discussed in more depth.

(3) Regarding the dust emission and deposition fluxes, in Figure 2 global results are shown. If only Saharan land surface conditions are modified for 6K compared to 0K, the differences in the rest of the world can only be due to the changed orbital parameters. This should be stated clearly in the text. Figure 2 would be more useful if not only the fluxes for 0k and the differences between 0K-6K would be shown, but if the actual emission and deposition fluxes for 6K would be shown as well in additional panels.

Minor comments:

- The title does not really reflect the content of the paper. The work focuses on the dust modelling, while the title implies that the investigation of the sediment records is at the center of the work, which is not the case. The title should be modified to better reflect the content of the paper.
- Page 5272, line 3: 'at variance' is unclear, you probably mean 'inconsistent' or similar
- Page 5273, Model description: Is the ECHAM version 6.1 or 6.3 used for the computations?
- Page 5276, line 8: what does 'low stature vegetation' mean?
- Table 1: Why are the results for ECHAM6-HAM2.1 different in this study compared to Stanelle et al., 2014? Is this the difference between 0K and modern dust? Please clarify.
- Table 2: AO6kL6kL0k (last line) should probably be AO6kL6kV0k
- Table 3: If the greenhouse gas levels are the same for 6k and 0k, why compare them

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in the table? Just stating the values once would be sufficient.

- Some of the figures could be improved by increasing figure labels. In particular in those figures where 0K and 6K results are compared, this should be clearly labelled.

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