

Interactive comment on “Modeling dust emission response to MIS 3 millennial climate variations from the perspective of East European loess deposits” by A. Sima et al.

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Dear Referee,

Thank you very much for your comments and helpful suggestions. Please find below our answers. A revised version of the manuscript (text and figure captions) is included as a supplement.

1. Dust accumulation rate is mostly used by the loess community as a proxy of source region aridity while grain-size is usually interpreted as an indication of wind strength. Different views also exist although the voice is not so strong. It would be finer if the paper can provide some discussions on the links between the source extents (the
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sizes) and dust accumulation rate, based on the experimental results. At least, the current discussions are not clear enough relative to this issue.

Our offline dust calculations only give mass emission fluxes at the surface. The areas where significant emissions occur are more extended in the cold “stadial” GS and “H-stadial” HE experiments than in the warmer “interstadial” GIS one (Fig 4.). Without a transport and deposition model, we cannot calculate the impact on the deposition rates. Nevertheless, also taking into account that the simulated slightly lower precipitation and slightly stronger winds in the GS and HE states favors the transport compared to the GIS state, we may reasonably suppose that more emitted dust would lead to more deposited dust in the cold North-Atlantic episodes than in the relatively warmer ones.

We have introduced this explanation in the Discussion as follows:

The vegetation effect not only determines a strong decrease of the GIS emission fluxes compared to the GS ones, particularly in the most active spots, but also decreases the size of the band where significant emission occurs (Figs. 4, 9). Without a transport and deposition model, the impact on the sedimentation rates cannot be calculated. Nevertheless, as the simulated slightly lower precipitation and slightly stronger winds in the GS and HE states favor the transport compared to the GIS state, we may reasonably suppose that considerably more emitted dust would lead to considerably more deposition during the cold North-Atlantic episodes than during the relatively warmer ones, in agreement with the loess data.

2. The discussions on the dust grain-size invoked both wind strength and the relative contribution of the nearby vs. remote sources. Could their roles be addressed in a more explicit way?

In our understanding, they are related. A layer of a given thickness, for example 1 mm, of dust deposited at a given location in strong wind conditions will contain fine-to-coarse grains from nearby sources, and mostly (or only) fine material from more remote sources. If the winds were even stronger, more of the medium-to-coarse material from

the nearby sources could reach the deposit, while from the remote sources still mostly the fine material could arrive. Thus, the same 1 mm of deposited dust would contain more material (especially coarser), from the nearby sources, on the expense of the remote source contribution.

In the Discussion, we have introduced the explanation as follows :

Qualitatively, as the sandy laminations, the grain-size peaks (reflecting coarser deposition) are interpreted as indicating episodes of particularly strong wind. Such very strong winds are able to bring more medium-to-coarse material from the nearby sources to the considered deposition site, while from the remote sources still only finer material can travel the longer distance. Thus, the coarser deposition also reflects an increased relative contribution of the nearby vs. remote emission areas to the sedimentation at a given site.

3. If it is possible to generate two curves from the model outputs, showing the dust content and grain-size changes with the elevation? This would be interesting for loess geologists to compare the sites at different elevations, although it is clearly not the focus of the present manuscript.

The dust emission calculations only give mass fluxes at the surface, we are not able to generate such curves. We will keep in mind this question when preparing numerical experiments including dust transport and deposition. However, we would mention here at least one aspect limiting the possibility of a meaningful comparison to data: Typically, loess deposits contain a significant fraction of medium-size to coarse grains, most of which are only carried at low altitudes, on short distances (from a few kilometers to a few hundreds of kilometers). Models mainly represent fine particles (up to 10 μm), susceptible to be lifted high in the atmosphere and transported at long distances (many hundreds and thousands of kilometers), thus having a significant impact on the atmospheric radiative budget. In principle, coarser particles could also be treated, on the condition to work at a model resolution fine enough in both horizontal and vertical

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directions. For a dust particle to make a difference in the model, it should be able to travel at least from one grid cell to its neighbor. Just to give an idea: the resolution of the zoomed grid we use here, down to 60 km on Western Europe, is very fine for an AGCM, but still, 60 km is a distance comparable with the width of the Rhine valley.

4. There is a room to improve the text. Especially, some paragraphs are so long that the readers would feel hard to follow.

We identified and split some paragraphs that were much too long indeed. We hope this aspect is fine now.

Please also note the supplement to this comment:

<http://www.clim-past-discuss.net/9/C407/2013/cpd-9-C407-2013-supplement.pdf>

Interactive comment on Clim. Past Discuss., 9, 143, 2013.

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