Referee1

Interactive comment on

"Linkage between Dust Cycle and Loess of the Last Glacial Maximum in Europe"

by Erik Jan Schaffernicht et al.
Anonymous Referee #1 Received and published: 23 October 2019
Comments to "Linkage between Dust Cycle and Loess of the Last Glacial Maximum in Europe" by Schaffernicht et al.

Manuscript number: acp-2019-693

R= Referee1

A= Authors' reply

R:
Quantification of the dust cycle for the Last Glacial Maximum (LGM) is crucial to better understand effects of dust on glacial paleoclimate and paleoenvironments. Loess deposits are paleodust archives providing basic information to test dust cycle models such as the one introduced by Schaffernicht et al. This dust cycle simulation is novel in the sense that it follows a weather typing approach (circulation weather type, CWT, classification) providing deeper insight into regional differences of peak glacial atmospheric circulation in Europe and dust emission/deposition in relation to CWT classes. As demonstrated by the authors simulated bulk and dust MAR values are in good agreement with the paleodust record (loess MARs) in central Europe, and this study reveals the significant role of easterly and cyclonic wind regimes in LGM dust emission and dust emission/deposition seasonalities (summer/autumn peak). My limited number of (minor) comments/suggestions can be found below as line-by-line comments. This manuscript is recommended for publication in ACP after minor revisions.

A:
We thank Referee1 very much for the suggestions and comments on our manuscript as they contribute to improving the submitted manuscript. Our point by point answers to Referee1's comments follow.

Specific comments

R1.1 Lines 41-46: Bulk and dust MARs should clearly be distinguished in this paragraph, and later in the text.

A These terms are consistently used in the complete manuscript:
1) "MAR":
MAR is equivalent to "bulk MAR". It refers only to fieldwork-based reconstructed accumulations rates without any limitation of particle size.

2) "MAR10":
MAR10 refers only to fieldwork-based reconstructed accumulation rates of particles up to 10 micron diameter.

3) "dust deposition rates":
This term refers to only any kind of numerical-model simulated deposition rate without limiting or specifying its particle size range. For example, the particle sizes range in the WRF-Chem-LGM includes particles up to 20 micron.

4a) "F_{D20}":
It labels the WRF-Chem-LGM simulated deposition rates up to 20 micron particle size.

4b) "F_{D12}":
It labels the WRF-Chem LGM simulated deposition rates up to 12 micron particle size.

4c) "F_D":
It refers to F_{D20} and F_{D12}.

R1.2 The dust MAR value (100 g/m2/yr) in line 43 is slightly misleading, as this is an estimate of MAR of the <10 micron fraction, so cannot be directly compared to bulk MAR (800 g/m2/yr), as given in the next sentence.

A Referee1 claims that the 100g/m2/yr (i.e. the upper limit of the numerically-simulated deposition rates of the cited studies) is an estimate based only on MAR10 (= "MAR of the < 10 micron fraction").

This is not the case, i.e.: The 100g/m2/yr are no estimate of the MAR10.

Reasoning:
Only two of the five references that we cite to prove our statement are based on simulating particles < 10micron. In one of the remaining three references, for example, the particle size is limited by 1000micron.

In summary, the 100 g/m2/yr bases on at least five published simulation results, all of which differ from one another in their particle size ranges. This upper deposition rate limit (= 100 g/m2/yr) can thus not be related to a common particle size range. At least two studies explicitly use a particle size range that exceeds 10 microns.

Thus, our statement that the numerical simulations published up to now significantly underestimate the field research-based reconstructed accumulation rates for the LGM, remains valid.

R1.3 Lines 150-151: Significant loess accumulations are found along the west bank of the Danube river in Hungary, Croatia and Serbia, providing further observational evidence for easterly paleowinds.

A Referee1's statement is very much appreciated. If Referee1 provides us with a full reference to a peer-reviewed article confirming this, we will be happy to include this loess-related statement in the manuscript.

R1.4 Figure 4:
a) Position of the scale is inappropriate as it covers circles representing MAR magnitudes.

A The position of colour bar was intentionally set like this to provide more space for the important content, i.e. the panels showing the maps. This design was chosen because the order of magnitude of the MARs are represented solely by the diameter of their circles. It is therefore sufficient to display only two thirds of a full circle line to uniquely define and recognize its diameter.
However, if Referee1 (after reading this reasoning) continues to insist that all circles are shown completely above the colour bar (which means that the main content of the figure is reduced), we will comply to his/her request.

R1.5 b) Also, I suggest adding an x-x plot directly showing a model/paleodata comparison of dust MAR values.

A Such an x-x plot (R1.5-Fig. 1) showing the WRF-Chem-LGM-based dust deposition rates compared to the MARs can be found below.

The x-x plot shows that the WRF-Chem-LGM based dust deposition rates are in good agreement with the fieldwork-based reconstructed MARs. Ultimately, it must be taken into account that the reconstructed MARs for certain areas show great local variability, the cause of which is probably due to conditions that can still not be completely resolved in the applied WRF-Chem-LGM grid. It is therefore possible that some small-scale features cannot be reproduced in the grid resolution of this study. In addition, the small-scale land surface conditions in Europe during the LGM are so far not sufficiently known nor researched.

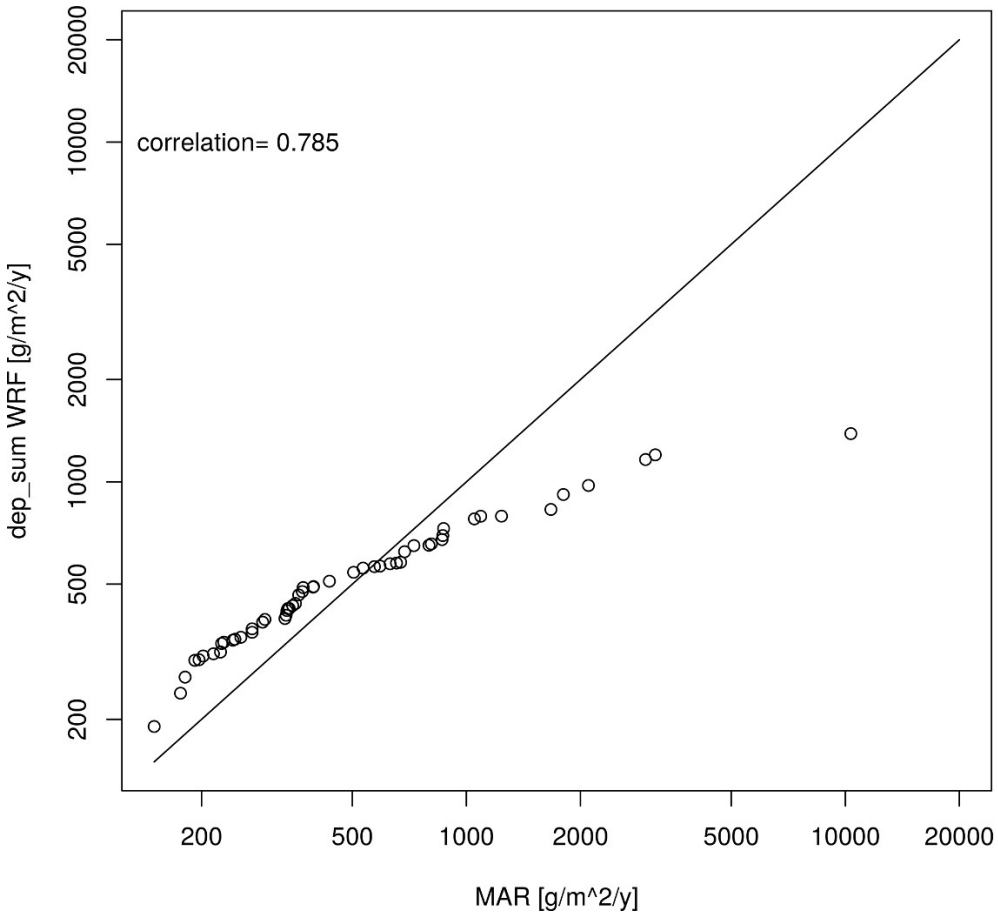

Figure 1

R1.6 Lines 268 and 278: The dimensions should be g/m2/yr and not kg/m2/yr, I guess.

A Thanks for this comment. In the new version, this is corrected.

R1.7 Lines 297-298: State clearly if this is bulk or dust MAR.

A "The largest dust deposition rates during the LGM occurred […]" refers to the WRF-Chem-LGM simulations. Any other wording would be inconsistent with all other sections of the manuscript. A further distinction between WRF-Chem-LGM particles up to 12 microns and up to 20 microns is not necessary here, since this sentence applies to both deposition rates (based on 12 and 20 micron). If we had referred to results from fieldwork, we would have used the terms MAR (or MAR10) instead.

Technical corrections

R1.8 Line 29: Ujvari et al (2012) is not listed in "References"; is this the cited study of the authors from 2017?

A Due to a UTF-8 sorting error, it is listed at the end of the References list. Thanks for pointing to this. In the new version, the References list is re-sorted.

R1.9 Line 42: Ujvari et al. (2010) cannot be found in the reference list

A Thanks for pointing to this; in the new version, this is corrected.

R1.10 Line 133: missing full stop at the end of sentence

A Thanks for pointing to this; in the new version, this is corrected.

R1.11 Line 249: write "average dust emission"

A Thanks for pointing to this; in the new version, this is corrected.