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Interactive comment on "Mineral dust modelling with MADE3 in EMAC v2.54" *by* Christof G. Beer et al.

Anonymous Referee #2

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The article presents EMAC model results for atmospheric mineral dust which are evaluated using aircraft, Lidar and sun photometer observations. The authors combine the MADE3 aerosol microphysics submodel with the online dust emission scheme by Tegen et. al.. While both have been presented and implemented in previous studies, to my knowledge the combined application is new.

The evaluation makes use of measurements from the SALTRACE campaign which focussed on Saharan dust, and AERONET retrievals from stations in and surrounding the Sahara. Consequently the Sahara as the globally most important dust source is well represented, but other sources, e.g., the Asian deserts, are excluded from the evaluation. In this regard I would have appreciated a more complete evaluation, considering that EMAC is a global model and most often used for global studies. Nevertheless, I

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believe that in the present form the article serves the authors' purpose of guiding future model setups.

Therefore I recommend to publish the article, which is generally well organised and written, after addressing the following comments.

Section 1

Given the modular nature of EMAC, to put this study into the context of existing EMAC studies, it might be worth to briefly relate MADE3 to other aerosol submodels such as GMXe.

Section 2.2

What are the size ranges used for the Aitken-, accumulation- and coarse modes?

Figure 1

Specifying which line corresponds to which mixing state suggests some meaning in the relative locations of the maxima, but supposedly the distributions are just examples? Do the grey shades indicate some thresholds at 0.1 and 1 um?

Equation (1)

"(1 + u_thr^2(i) / u^2)" should read "(1 - u_thr^2(i) / u^2)"

Page 6, line 16

Please define how you quantify soil humidity, in particular please mention the meaning of the value 0.99, is it the fraction of the field capacity?

Page 7, line 2

Please be more specific, I assume that not all size classes are summed to a single flux and distributed into the two modes only afterwards, but that some classes are summed to obtain the accumulation mode flux, another sum yields the coarse mode flux.

Page 7, line 5

Better use "sigma_g" instead of "sigma" and introduce as "[...] geometric standard deviation sigma_g = 1.59 [...]".

Figure 3

The time period used for this plot is shorter than the AERONET period specified in Table 3. If this is just for clarity, it should be pointed out in the caption to avoid the suspicion of cherry picking. For the same reason it should be mentioned that the plot shows data from the station which benefits most from the online dust emissions. I suggest to include the corresponding plots for the other stations of Figure 4, using the full 5 years, in the supplement.

Section 3.3

A direct comparison of the two emission size distributions (reference and SAMUM-1) would be helpful, particularly because it is not immediately clear what diameters Eq. (4) produces.

Figure 7

Since it is taken from aircraft measurements, do you expect the SAMUM-1 size distribution to be already affected by transport from emissions to observations? This would mean a slight bias towards smaller particles, consistent with the figure.

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