

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2022-94

Anonymous Referee #1

Referee comment on "Modeling coarse and giant desert dust particles" by Eleni Drakaki et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-94-RC1>, 2022

This study investigates the incorporation of coarse and giant desert dust particles (with diameter greater than 20 μm) in the WRF model, together with the GOCART aerosol model and the AFWA dust emission scheme. The authors implemented a number of extensions to the original model. More specifically, they used a prescribed dust particle size distribution for emitted dust particles at the source based on in situ measurements from the FENNEC campaign and employed 5 size bins with diameters up to 100 μm (corresponding to giant particles). Moreover, they implemented an updated drag coefficient that applies to the above bins and is representative of high values of Re number. The simulations were performed from 29 July to 25 August 2015. The model output were validated against various observational datasets.

The article is well written and promotes the research in the modelling of the desert dust. The use of English is excellent and the conclusions are supported by the results. It is suggested to accept this article for publication after some minor corrections are performed.

Suggested corrections:

Section 2.1.3: please include a) whether the vertical levels (line 220) were defined by WRF or by the authors (providing how you chose them in the latter case), b) which UTC time was chosen for the original initialization/each re-initialization (line 221), c) some more detailed information about the model results that you used from each 84 hour run (i.e. whether you removed the first 12 hours of each run due to model spin-up and utilized the rest; line 221), d) the topography and land-use datasets, e) whether the sea-surface temperatures were updated from GFS-FNL analyses every 72 hours at the initial time of each run or every 6 hours together with the lateral boundary conditions.

Line 369-373: Have you validated the simulated upper air wind field, e.g. using ERA5?

Western Africa is characterized by a complex wind regime. There is a large area with pink colors (i.e. dust) in area B of Figure 7f. Therefore, the dust errors may be also due to erroneous wind field.

Technical corrections:

Line 23: "... diameters of 5.5-17 μm ..."

Line 129: "... are shown in Table 1."

In equation 5, C_D must be replaced by C_D/C_{cun} (following the terms of equation 4) or by the equivalent $C_{D,\text{slip}}$ of equation 11.

Line 178: the units of μ should be $\text{kg m}^{-1} \text{s}^{-1}$ so that equation 9 to be unit less.

Line 180: please correct the numerator of μ (i.e. 1.4.58).

Line 182: "Equation 8 has been derived ...".

Line 183: "... Davies (1945) ...".

Line 184: "... drag coefficient becomes:".

Line 193: "... Substituting Eq. 6-9 in Eq. 5 ...".

Line 197: "... Stoke's Law (Eq. 11) ...".

Line 200: "... of Eq. 14, proposed ...".

Line 226: please include the full name of DOD (Dust Optical Depth) at its first appearance in the article.

Line 339: Ryder et al. (2013a) or (2013b)?

Line 367: "... and the MIDAS DOD ...".

Line 385: "... as shown in Fig. 5."

Line 391: "... for bin 5 (40-100 μm)."

Line 397 and 833-834: What is the domain of interest? Were the results averaged in the whole model domain of figure 3 from 5 to 25 August 2015?

Lines 397 and 830: the Livas pure-dust product is illustrated with the red line.

Line 423: "... 0.066 m/s for particles with D between 5.5 and 17 μm ..." according to line 390.

Line 428: "... compared to this study ...".

Lines 438, 457, 461, 468: "Mallios et al. (2021)" because there is no Mallios et al. 2021a or Mallios et al. 2021b in the References section.

Line 476: "... asphericity ...".

Line 781: "... b932 and b934 are also ...".

Figure 3: are the symbols of each flight below its maximum height necessary? They are hidden by the symbol of the highest flight of each run. The other information (flight

number, run, height) must remain. Moreover, some runs of figure 9b (b924_R04, b928_R02, b932_R02, b934_R04) and figure 8 (b928_R02) are not included in figure 3, while b932_R05 appears in figure 3, but not in figure 9b.

Line 817: please clarify how were the uncertainties calculated? At what significance level?

Line 825: please add b928_R02.

Line 834: please add in the caption what are the vertical dashed lines in region II.

Table 2: The MM5 surface layer scheme is 1 or 91 in WRF 4.2.1, but not 2.