

Atmos. Chem. Phys. Discuss., referee comment RC2  
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## Comment on acp-2021-809

Anonymous Referee #2

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Referee comment on "Large-eddy-simulation study on turbulent particle deposition and its dependence on atmospheric-boundary-layer stability" by Xin Yin et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-809-RC2>, 2021

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The authors use large-eddy simulation (LES) to investigate the influence of turbulent shear stress / momentum flux on dust deposition. Using a shear-stress weighted average of dry deposition velocity, they derive a modified version of a dust deposition scheme and obtain improved results compared to the LES dust deposition.

The subject of investigation is important and tests of the impact of the improved parameterization on the spatial distribution of dust deposition in a regional or global model are desirable in a future study. The manuscript is well structured. I therefore recommend publication of the manuscript after consideration of the following comments, which are overall minor:

- How is dust deposition (velocity and fluxes) calculated in the LES? Is the deposition scheme from Zhang and Shao (2014) used here as well? This does not become clear in the text.

- Apart from the two different roughness lengths, the LES simulation design (domain configuration, simulation setup, cases) seem to be exactly as in Klose and Shao (2013), as are components of the analysis of the shear stress distribution. It should be made clear in the text that parts of the study design follow Klose and Shao (2013).

- Data used in the paper is made available online, which is great. Ideally, I think a format which is independent of the programming language used would be preferable. Currently npy is used, which requires python. This is only a recommendation.

Line 9-10 While there are studies on the effects of atmospheric boundary layer stability (ABLS) on dust emission, I do not agree that they are as clearly documented as the

sentence suggests. Stability is not typically considered in dust emission schemes. I propose to revise the sentence.

Line 26 When stating that several dust deposition schemes have been proposed, I recommend listing more than two.

Line 43-44 Please add reference.

Line 50-53 This is (almost entirely) a direct citation from Klose and Shao (2013) and should be indicated as such.

Line 56-57 Sentence (current dust-deposition schemes only consider the mean wind) needs reference.

Line 60 to accurately model

Line 77 What do you mean with "reasonably well-established"?

Line 82 "nonlinear backscatter and anisotropic" – please check grammar

Line 92-95 I presume the description of  $\tau_{ij}$  is inherent to WRF, in which case a reference should be added.

Line 99 divided by

Line 107 where  $K_m$  is eddy viscosity and  $\phi_m$  is the MOST stability function

Line 112 with "on grand" do you mean grid-resolved or grid-scale?

Line 114/115 as the change of dust concentration close to the surface

Line 117 The combination of the two references given for dust emission is a little confusing, as the Shao (2004) paper deals with a dust emission scheme (without consideration of turbulence effects) and the paper from Klose and Shao (2013) deals with turbulent dust emission, but is no dust emission scheme (the corresponding references would be Klose and Shao (2012) and Klose et al. (2014)). Please clarify what the intention is here and update the references accordingly.

Line 118 settling instead of settlement

Line 134  $r_g$  should be defined at its first occurrence directly after Equation 10.

Line 137 Please indicate the particle-size regime for which the Stokes assumption of a linear dependence of drag coefficient on particle Reynolds number, which is used here, is appropriate.

Line 141 assumption that dust concentration is zero

Line 156 with beta ... being the ratio...

Line 158 for particles with diameter

Line 160 gravitational settling

Line 189 remove "below"

Line 207 Do you mean "decreases with increasing wind speed"?

Line 211 ABLs, buoyancy

Line 226 fluctuating behavior

Line 287 performance

Line 291-292 Check grammar

Line 295 To predict

Fig. 5 Check and use consistent labels (e.g. scatter/line versus circle/line)

Line 316 while it becomes

Line 326 Please state how you calculated the Richardson number.

Line 328 associated with

Line 338 In principle the deficiencies have only been shown for one dust-deposition scheme, even though from a conceptual point of view, this means that it applies for other schemes as well. I suggest to rephrase the sentence slightly to account for this nuance.

Line 342 embedded

Line 346 can be approximated with a Weibull distribution

Line 351 on regional or global scales

Line 352 the variation of tau may be changed (or affected) by surface roughness