

Interactive comment on “Comparison of the size-resolved dust emission fluxes measured over a Sahelian source with the Dust Production Model (DPM) predictions” by M. Sow et al.

Anonymous Referee #1

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General comments:

This study addresses the important dependency of the initial size distribution of emitted dust particles on surface properties and surface wind speed. Simulations of size-resolved dust emission fluxes are performed for three dust events using the Dust Production Model of Alfaro and Gomes (2001). The model is initialized and evaluated with the comprehensive set of field measurements of meteorological parameters, size-resolved dust emission fluxes and the soil size distribution presented in a previous publication by Sow et al. (2009). The model shows promising results in terms of total dust emissions, when a tuning factor is applied. The computation of size-resolved dust

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emission fluxes requires further model improvement.

Alfaro et al. (2004) explained that a tuning factor is needed as “a certain dependence of [...] [the kinetic energy of saltating aggregates] to soil characteristics may exist in natural conditions”. Here, the authors relate the underestimation of emission fluxes to lower friction velocities resulting from averaging of meteorological parameters. Is it possible that both explanations are true and that the binding energies have to be adapted to each different dust source? This might be also true for the mean diameters of the three populations of released dust particles. If the friction velocities are systematically underestimated, a tuning factor must be also applied to the saltation flux (lowering the threshold friction velocity for initial particle mobilization).

Specific comments:

Page 11078, Line 12: From a meteorological point of view, I would suggest “less windy” instead of “less energetic” (also later in the text, e.g., page 11093). Line 20: Add “in the DPM” after “than previously assumed”.

Page 11079, Lines 14–16: You might simplify or split this sentence into smaller parts to increase legibility. Line 24: In order to avoid confusion with model simulations in this study, wind tunnel tests should be referred to as experiments (also later in the text). Line 26: The phrase “finest PM₂₀” is imprecise and inconsistent, give a size range here.

Page 11080, Line 3: The comprehensive data set of meteorological and dust flux measurements is actually unique so far. However, the finding that the size of emitted dust particles depends on prevailing atmospheric dynamic conditions is not novel.

Page 11083, Line 18: Again, replace “finest PM₂₀” by a size range.

Page 11084, Line 7: Are there also inorganic non-erodible elements? Use “etc.” instead of “. . .”. Lines 14–19: Could the convective conditions interfere with the determination of z_0 ?

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Page 11085, You could try to estimate a range of “gusty” u^* on the basis of the wind speeds at 1-min resolution. At least, the range of surface wind speeds would give an idea of possible values of u^* . Would that range of u^* explain the order of magnitude of the tuning parameter?

Page 11087, The terms “horizontal mass flux” and “vertical mass flux” were never introduced before. Readers who are not familiar with this terminology might be confused, in particular as “vertical mass flux” only appears in the header of this section and in line 6 on page 11088. The definitions should be consequently used throughout the text. Line 17: The explanation for “gsd” is not given until page 11091. The standard deviation was introduced as sigma on page 11083, please unify. Line 27: Correct “. . . have the values proposed by/assumed in Alfaro and Gomes . . .”

Page 11088, Lines 5–9: You should split this sentence into two to increase legibility.

Page 11092, Line 17: Does “energetic conditions” mean “high wind conditions”? Line 25: What is the average of gmd defined?

Page 11094, Lines 11-14: Restate the sentence. Field measurements do not provide the output of the model, but the basis for model evaluation. Lines 24–28: Split this sentence into at least two separate sentences.

Page 11095, Lines 21–25: Split this sentence into at least two separate sentences.

Page 11096, The second explanation of the saturation effect was not discussed before in the text.

Table 1: Please, change the order of geometric mean diameter and standard deviation. The table caption needs revision: “Number, geometric diameter and standard deviation of 3 log-normally distributed populations, which represent the dry size distribution of loose soil aggregates at the Banizoumbou (Niger) super site.”

Table 3: For a comparison, you could add a column with the values assumed in the DPM by Alfaro and Gomes (2001). “particles/m²/s” use the same units as in the figures

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(#/cm²/s).

Figure 2: In the figure caption, there is no information on the fitted data. There is a significant difference between measured and fitted u^* values for [0.7-0.75] and [0.75-0.8]. Which u^* was used for dust flux calculation? If the fitted u^* values were used, could the underestimation of the last u^* bin explain the underestimation of dust emission fluxes?

Figure 3: It is difficult to identify, which diagram relates to which period. You should label each diagram and/or add an explanation to the figure caption. Figure labels should be readable from the right.

Figure 4: A figure caption should provide information on what is shown in the figure rather than a repetition of the text.

Figure 5: The left and right panels should be labeled, in order to clearly indicate whether a number or mass size distribution of dust flux is shown. What is the unit of u^* in the legends.

Technical comments:

Page 11078, Line 15: Add a comma after “In all the studied cases”.

Page 11080, Line 13: Correct “mass flux”. Line 26: Spaces are missing between figures and units.

Page 11081, Line 22: Correct “meet/satisfy these conditions”.

Page 11082, Line 23: A space is missing between figure and unit.

Page 11083, Line 14: A space is missing between figure and unit. Line 17/18: Correct “appears” and “surface on which”. Line 21: Omit “those”.

Page 11087, Line 11: Correct “0.5”.

Page 11088, Lines 5–9: Insert “is” between “beta” and “not fixed”.

Page 11089, Line 23: Delete “of” between “or” and “in terms of”. Restate: “. . . a unit of

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mass released per second and square meter, . . .”.

Page 11091, Line 23: Omit “ is tantamount to saying that it”.

Page 11094, Line 6: Delete “-“ after “(CE4)”.

Page 11095, Line 27: Insert “the” before “observations”.

Page 11096, Line 13: Correct “for its support”.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 11077, 2011.