**Geoscientific
Model Development
Discussions**

Interactive comment on "Importance of the surface size distribution of erodible material: an improvement of the Dust Entrainment And Deposition DEAD" *by* M. Mokhtari et al.

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Dust is a most abundant atmospheric aerosol component in terms of aerosol dry masses. Yet, dust, as well as sea salt, simulation has a higher uncertainty among major primary aerosol components due to its interactive parameterizations of the emissions and contrasting particles sizes concluded by a study of multi-model comparison within AeroCom [Textor et al., 2006]. This paper addresses this weak link in dust simulation by improving dust emission with a better description of the surface soil size distribution of erodible material. The topic of the paper is suitable for Geoscientific Model Development. I recommend publishing the paper after the authors address the following

comments.

Textor, C., Schulz, M., Guibert, S., Kinne, S., Balkanski, Y., et al.: Analysis and quantification of the diversities of aerosol life cycles within AeroCom, Atmos. Chem. Phys., 6, 1777-1813, doi:10.5194/acp-6-1777-2006, 2006.

General Remarks:

The paper adopts a theory that each soil texture class is linked to a specific soil aggregate particle size distribution. Does the change of soil aggregate distributions due to a change of texture classes translate to a change of emitted dust size distribution? This further discussion is important since dust size distributions not only affect dust simulation but also the role of dust in air quality and climate. If the dust emitted size distribution remains the same with various texture classes, which is consistent with the conclusion of a recent study by Kok (2011), please show the comparison of the distribution between this work and Kok's. Can you use Kok's distribution instead to revisit the study? If the dust emitted size distribution changes with texture classes, do you have any explanations for contradictory results between yours and Kok's?

Kok, J.,: Does the size distribution of mineral dust aerosols depend on the wind speed at emission? Atmos. Chem. Phys., 11, 10149–10156, 2011 www.atmos-chemphys.net/11/10149/2011/ doi:10.5194/acp-11-10149-2011.

There are a lot of terms, phrases, and sentences that require clarification. Some examples of these unclear definitions are given in the following specific comments. In addition, there are a number of grammar issues and awkward sentences. It would be good to ask someone for a careful "copy editing" read through.

Specific comments: 1. Page 2894 line 17: Can you indicate which approach gives better AOD simulation? 2. Page 2896 line 8: Please change "surface size distribution" to "surface soil size distribution" throughout the paper. 3. Page 2897 line 12: Why is '(in situ or after transportation)' needed here? 4. Page 2898 equation 1: M_j, D_{medj}, and j

should have p in their subscripts since they are also the function of soil texture classes as shown in Table 2. 5. Page 2898 line 23: What does "each particle" mean? Does it refer to a texture class, a specific texture, or other? 6. Page 2899 equations 3-4: It is hard to understand section 2.2. Need to clarify Stotal and Sp. Is Stotal a total surface of texture class P or is a total surface of all texture classes? What's Sp? Is it same as Stotal? Need to change 'dSrel' as 'dSrel,p'. Please explicitly indicate that this upgraded DEAD model uses four dust bins and the emitted dust size distribution over each model grid box depends on its erodible fraction (i.e. soil texture classes) of that box. 7. Page 2899 line 13-14: What's the purpose of calculating the average relative surface of the four populations? 8. Page 2899 line 20: Please define 'This last'. 9. Page 2900 line 18: Please clarify 'each class size'. Does it refer to each of 12 texture classes or each of four populations? 10. Page 2902 table 4: Elaborate on the motivation of designing the four experiments. Why is it important to test the influence of Moisture effect? Why does it not need to examine the influences separately from the formulation of horizontal saltation flux and the formulation of sandblasting efficiency α? 11. Page 2903 line 3-14: I do not understand the discussion. A figure or table to address the content of the discussion would be helpful. Similarly, please show results for the discussions on Page 2903 line 18-22, Page 2904 line 2-10, Page 2904 line 15-20, and Page 2904 line 25 to Page 2905 line4. 12. Page 2906 line 13: Where is the table 5? 13. Page 2907 line 24-25: What is the time interval between the previous and the next model runs? 14. Page 2908 line 20: Please clarify 'Different AOD maxima'. Different from what? 15. Page 2910 line 15-16: I am not convinced by the reason given by the authors that salt aerosols have less influence on the AOD due to their property of weakly diffused. Sea salt could enhance AOD significantly such as over Southern hemispheric storm track. The concentration of salt aerosols and the ambient RH are also potential reasons. 16. Page 2911 line 3: This work applies a regional model to examine an improved DEAD model over Africa only, thus 'globally' should be changed to 'over Africa'. 17. Page 2912 line 1: There is no cause-result relationship between the observation and the EXP4 and EXP3 predictions over Mbour. Therefore please delete 'therefore' in the

sentence and add '.' Before 'EXP4'. 18. Page 2912 line 22: What is 'That' referring to? 19. Page 2912 line 22: What is the purpose of this sentence? Why should the dust event on March 9-11, 2006 agree with climatology average? 20. Page 2913 line 6: You are not developing the DEAD model, but improving the model. 21. Page 2913 line 12: I think the Fecan formulation uses a high threshold (with lower moisture) so that Earth surface often can not meet this threshold to allow dust produced (e.g. dust underestimated in EXP 1).

Technical corrections 1. Page 2894 line 7-8: delete 'based on both ….'. 2. Page 2894 line 8: change 'arrangement" to "improvement". 3. Page 2894 line 13: change 'realized" to "conducted" or "performed". 4. Page 2895 line 25: change 'not known" to "unknown". 5. Page 2896 line 22: change '7-13 March' to 'March 7-13, 2006'. You need to indicate which year for the event when you mention it at first time. 6. Page 2896 line 25: change 'Sect. 2' to 'Section 2' to be consistent with your writing following. 7. Page 2896 line 27: change 'study' to 'studies'. 8. Page 2897 line 25: I don't understand the word 'messing'. Is it a typo of 'missing'? 9. Page 2899 line 17: Please move '(hereinafter referred to as MaB95)' to the first time it is mentioned in the text. Please use MaB95 hereinafter such as Page 2899 line 20, Page 2900 line 17, Page 2902 line 10, etc. 10. Page 2900 line 14-15: change '... due to the Oven effect and U10, U10,t are, respectively, the wind speed and ...' to 'due to the Oven effect. U10 and U10,t are the wind speed and the threshold wind speed at 10m, respectively'. 11. Page 2902 line 20: Please define 'ISBA'. 12. Page 2907 line 3: change 'have' to 'with'. 13. Page 2907 line 7: Please move 'the externalized surface scheme (SURFEX)' to the first time you refer it in the text and use SURFEX afterword. Same for ISBA. 14. Page 2907 line 17: What does 'MesoNH' mean? 15. Page 2910 line 11: delete "we register" 16. Page 2910 line 21: missing '.' after '14 March'. 17. Page 2912 line 11: change 'repartition' to 'distribution'.

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