

Interactive comment on “Development of a dynamic dust-source map for NMME-DREAM v1.0 model based on MODIS NDVI over the Arabian Peninsula” by Stavros Solomos et al.

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The paper proposes a dynamic dust source map based on NDVI values and use it in a dust model. The “dynamics” of dust sources is an important aspect of dust emission, which is currently not represented in many dust models. In this regard, this paper attempts to address an important concern of the dust modeling community. The paper is written concisely with great focus, which I greatly appreciate. However, some important relevant descriptions required are missing in the manuscript. In addition, it is not clear if the results dictate enough to justify the use of dynamic dust source map. My specific comments are given below:

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Line 52-59. It is mentioned that dust sources are represented by global datasets but it is not described 'how' exactly they are represented. Please describe how it is done, at least in DREAM. Please explain how exactly dust emission is affected when we use the new dust source map in the DREAM model. Please show and explain the detail of the particular equation that is affected. I believe the main change is the fraction of a grid point covered by desert surface, as in equation 3 of Nicovic et al., (2001).

60-73: You describe other works that used dynamic dust source map but it is not clear how your 'proposed' work is similar/different to these previous works. Please make it clearer.

78-79, in the 1) control run, do you use Ginoux et al. 2001 source map or Olson dataset? Please clarify the link between these two datasets.

91-99. this description is not so relevant to this study. It is not necessary to talk about partial differential equations or turbulent parameters here. This study is more about the dust source characterization so there should be more background or description from 'dust-source' point of view. A few sentences about the overall model description is sufficient. Rather, a brief description and comparison of different dust emission models currently in use, e.g., GOCART (WRF), DEAD (CESM), MACC etc., would be helpful for the readers. Also the literature on dust source map should be extended to cover the most recent developments in this topic. Some relevant starting references are given below: Parajuli, S. P and C. Zender (2017), Connecting geomorphology to dust emission through high-resolution mapping of global land cover and sediment supply, *Aeol. Res.*, 27, pp. 47-65, doi:10.1016/j.aeolia.2017.06.002. Ginoux, P., J. M. Prospero, T. E. Gill, N. C. Hsu, and M. Zhao (2012), Global-scale attribution of anthropogenic and natural dust sources and their emission rates based on MODIS deep blue aerosol products, *Rev. Geophys.*, 50(3), doi:10.1029/2012RG000388.

Line 103: Make it clear that August 2016 is test run but simulations are conducted for the whole year.

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107-108: is it updated monthly or every 16 days? In many models, it is generally updated monthly. Please clarify. Also please describe the 'numerical procedure' that you mention in more detail explaining how the NDVI data is used to define the dust sources.

112/113: Is this ratio a modification from Nicovic et al., 2001, equation 3? Please clarify.

120: how are those mountainous areas removed? Western Saudi region has many dust sources with intermountain deposits; make sure that you do not overlook these sources. See below for those dust sources. Anisimov et al. (2017), Quantifying local-scale dust emission from the Arabian Red Sea coastal plain, Atmospheric Chemistry and Physics, 2017;17(2):993-1015 DOI 10.5194/acp-17-993-2017.

Line 146: How is effective strength of dust source defined? It is not described clearly.

155-165: This paragraph belongs to the 'methods' section, not the results section. So it should appear early in the manuscript.

Line 156/157. Please describe how exactly the static Ginoux et al., 2001 dust source map was used in the model previously? Is the dust emission equation 'tuned' to achieve a target AOD as commonly used in many dust models? The comparison would be better if the control and NDVI run both were tuned to achieve some observed AOD value. Was the model tuned in some way to get a desired AOD? Figure 2b. Is this map showing the values from A_gridbox that you defined earlier? Please clarify what exactly are the plotted values. Figure 3 titles: May be DREAM-CTRL and DREAM-NDVI are better titles? Figure 4. Please describe Figure 4 in the text properly. Figure 5. Please describe Figure 5 in the text properly. Is it NDVI_run or NDVI_topo_run in the legend? I think you use topographic source function (Ginoux et al., 2001) in the control run so it is confusing. You may not need to set the color bar maximum value to 6.4, which is very high. A lower value of 1-2 would be sufficient.

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About the evaluation metrics used in the paper: This paper is about the benefit of representing 'dynamics' of dust sources. So the time-correlations should increase if the new changes are beneficial. Improvement in bias does not confirm that it is because of the better representation of the 'dynamical' aspect of dust sources. The simulated values of AOD and their range also affect the bias, which are sensitive to the process of model tuning. That is why I mentioned about tuning previously. In addition, the RMSE is reduced only in one case and it is increased in other three cases? What does this tell? We should perhaps think of better control and model experiments so that the comparison of the two is fairer and the difference will show the expected outcome.

Table 1. What are fractional gross errors and mean fractional bias? Why are they relevant here? I think it is not necessary to show these values.

Some minor typing errors: Line 6. Normalized difference . . . Line 9. One year Line 31. Precipitation process Line 68. ..be even .. Line 248/249: rewrite the first sentence, the main purpose

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