Geoscientific
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# Interactive comment on "New developments in the representation of Saharan dust sources in the aerosol-climate model ECHAM6-HAM2" *by* B. Heinold et al.

## Anonymous Referee #2

Received and published: 9 October 2015

In this study, the authors use a satellite-derived mineral dust source area distribution to prescribe preferential dust sources in the climate model ECHAM6-HAM2. The authors report a large increase (15 to 22%) in total mineral dust emissions compared to the previous version of the model. Comparisons to observations show generally modest improvements.

The paper is well-written, and the analysis is straightforward. Figures illustrate the results and discussion well. I however recommend revisions to improve two aspects, as detailed in my comments below. First, to place the paper more clearly in the context of ECHAM development. Second, to improve the comparison between model and observations with a method that is less influenced by different sampling of model and

observations. Those improvements should amount to major revisions.

In addition, I encourage the authors to think about postponing the paper until they have run the free-running simulations that they mention in the conclusion (page 7897, lines 17–19). Although the paper could be published after the authors have addressed the comments below, it would be a relatively minor contribution to the literature. Analysing free-running simulations would give more breadth to the discussion. I also doubt that a standalone paper on free-running simulations could be published, as it would really be incremental, so if free-running results are to be discussed, it is now.

## 1   Main comments

- The changes brought by the MSG-derived DSA are essentially neutral. What decision was made in the end? Does ECHAM6-HAM2 now use the MSG DSA distributions, or did the authors keep the previous representation by Tegen *et al.* (2002)? The conclusion is unclear on this point (page 7897, lines 10–19).

  From a model development point of view, I am also surprised that revisiting the simplified assumption made for roughness length (Pages 7884 and 7885, lines 1) is not given more priority than changing the DSA dataset. A more realistic roughness length dataset is dismissed on the ground of failed tests in the past (page 7884, line 4), but that is hardly satisfactory. Why not take the opportunity to see whether combining satellite-derived roughness length and DSA datasets yield better results?

- Page 7891, line 7 and Figure 6: Comparing against satellite retrievals is obviously useful, but their sampling of the dust distribution is very different from that of the model. It is easy to reach misleading conclusions from such comparisons. Applying each instruments' retrieval mask on an hourly basis would be the best way to do the comparisons properly (especially since the model is nudged), but if

that is not possible at this stage, I would at least expect a masking on a monthly basis. In any case, comparisons as they currently are do not tell much about model skill and how it has changed after using the MSG DSA.

Note that the same remarks essentially hold true for comparisons against AERONET.

## 2 Other comments

- Page 7886, lines 6–7: I understand that getting closer to a multi-model average is reassuring, but that is not necessarily a good thing. Are there observational estimates of total Saharan dust emissions that could be more usefully compared against?

- Page 7887, line 1: "a *lower* emission flux limit"

- Figure 3: Isn't comparing MSG DSA against ECHAM-HAM(MSG) a bit circular? I agree that the model can (and does) still get the emission flux wrong, but I do not think that we learn much from that comparison.

- Page 7890, line 23: Water vapour is only really a problem for infrared retrievals, not so much for MISR.

- Page 7893, line 22: What does the 65% figure really mean? Looking at Figure 7, I would expect smaller percentages. Is that 65% of emitted mass rather than of total events?

## 3 Technical comments

- Page 7884: Typo "budget"

- Page 7885: "two-fold ways" → "two ways"

- Figure 5: Legends and insets are not legible.

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