Atmos. Chem. Phys. Discuss., 8, S9030–S9035, 2008
www.atmos-chem-phys-discuss.net/8/S9030/2008/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Saharan dust transport and deposition towards the Tropical Northern Atlantic" *by* K. Schepanski et al.

K. Schepanski et al.

Received and published: 12 November 2008

The response to the reviewers comments are indicated by italics.

The idea of this paper is interesting and publishable, however the way the paper is presented right now suggests the paper was produced without sufficient time and energy invested in the paper. The manuscript had substantial issues with differentiating new material from old material. There needs also to be more consideration of how sensitive the results are to the model used, and more analysis needs to be done before we can consider the model reliable for the results presented. In addition, the paper had numerous English problems. Most of these problems may be solvable by editing, although more comparisons to observations may be required (If not done in another previous paper). More details are indicated below.

Section 3: I found this section interesting in its synthesis of information on dust transport, however I think there needs to be a more delineation of what is new in this paper, compared with what is hypothesized elsewhere. And what is the result of this model versus other models: Are all your arguments consistent with previous arguments? What is new?

Parts of this section have been rephrased to make the distinction of background information, observations and modelling results. Now the first part of this section is divided into two separate sub-sections. Furthermore, the discussion on the comparison of modelled AOT distribution and satellite observations is enlarged. Beside AOT observations provided by MODIS at visible wavelength, AOT retrievals using the deep-blue part of the spectrum and the UV Absorbing Aerosol Index (AI) applied to OMI measurements is shown to validate the modelling results on the one hand and to point to different sensitivities of the satellite retrieval itself.
The comparison of the modelled AOT with AERONET data is extended and includes now available level-2 data for several stations located over and around the Saharan sector to characterise the temporal evolution of crossing dust plumes and its optical thickness at different latitudes. This accounts for the seasonally changing extent and location of Saharan dust plumes.
Furthermore, horizontal and vertical description and validation allows to draw a three dimensional impression of dust transport path and the limits of the model simulations under seasonally changing atmospheric conditions.

In Section 3.1, for example, there is a very nice conceptual model of dust transport put forward in Karympudi et al., 1999 or Westphal et al., 1987, but I see no reference to these papers, or information telling me what is new or different in this paper vs. previous papers. Similarly, in Section 3.6 (and parts of Section 3.3) , the conclusions (AOT not related to deposition) are similar to Mahowald et al., 2003, but

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there is no reference to this paper.

The above mentioned references are now included. Please note the new numbering of the sections.

Section 3.2 provides model output: how sensitive is this to model set up? Does the model capture the observed wet deposition to dry deposition ratios? Is the model getting the right size distribution compared to the AERONET or other data? Why should we trust the model?

Measurements on deposition fluxes are sparse over this domain. Here, the authors assume that a reproduction of AOT fields basing on the atmospheric dust concentration and particle size distribution implicitly points to a correct treatment of emission, transport and depositions processes. Otherwise this will result into a different AOT pattern compared to the observations.
A comparison of modelled size distributions to AERONET derived size distributions is added as suggested by the reviewer (new Section 3.3).
In addition, the AOTs and particle size distribution computed by this model were shown to agree well with measurements in detailed comparisons for other dust case studies in Tegen et al., 2006, Heinold et al., in press (Tellus).

Section 3.3: for the vertical profiles shown here: similarly there is no comparison of the model to observations (even if for the wrong year, there are some vertical profiles from ACE-2(?) and from GLACE) or indications why we should trust the models vertical profile.

Visual comparisons of vertical dust distributions with CALIPSO profiles shows good agreements in height and location of the simulated dust plumes. A detailed comparison of both modelling results and CALIPSO soundings will be a subject of an

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additional study.

Conclusions: for this set of simulations, you only look at one year, and a few months. Please make sure your conclusions are consistent with the very limited set of model runs you used for the analysis. Please consider how sensitive your results are to the model used, years simulated, etc. Please also consider how your study adds or contrasts with previous studies. There is a little too much claimed in the conclusions, which seem to indicate that the authors are claiming these results are new.

The conclusion section is rephrased to emphasise that the results refer to these specific case studies.

A few technical issues with the presentation: Alternatively, geostrophic forces may lead to acceleration of the air mass above the nocturnal BL up to super-geosptrophic wind speeds, a nocturnal low-level jet (LLJ) develops (e.g. Nappo, 1991; Banta et al., 2006; Schepanski et al., 20081) and the elevated air mass with its dust content is transported away from the source area (Kalu, 1979). Geostrophic forces are really false forces8211;this is from angular momentum conservation. Please be more precise.

A short explanation on the role of geostrophy for the LLJ development is added.

In winter months, transported Saharan dust is observed and reproduced by re-gional model studies near the surface, while in summer the dust layer is elevated. And not captured by the model???

It is captured. This part is rephrased.

Due to northward shift of the ITD (inner-tropical discontinuity, marking the meet-

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ing of dusty desert air and tropical moist air) the BL is deeper during summer which results in a higher upward-mixing of dust (also because of more insolation during the summer, so surface heating is larger)

This aspect is now considered as well.

Finally, the English needs to be substantially improved before publication is possible by careful reading of every sentence. Shown here are a few examples, but the improvements are not limited to these: there were too many issues to list here.

Thank you for your corrections!

This paper aims to show exemplarily for three single case studies the characteristics as well as the differences of dust transport concerning e.g. direction, height, and amount, and dust deposition2 towards the eastern tropical North Atlantic in different seasons. remove exemplarily

done

The contribution of dust emitted over the Bodele Depression to the total exported Saharan dust will be determined. Replace determined with estimated.

done

This aims at the question whether it is possible to derive dust deposition from AOTs based on measurements of space borne instruments like e.g. MODIS or SeaWiFS. : rephrase this is awkward.

done

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Meteorological and hydrological fields used for the simulation of dust emission, transport and deposition, are computed by the LM and updated in MUSCAT at every advection time step of 80 s. what does of 80s mean?

It means, that at every simulation time step of 80s meteorological field computed by the LM are given to the MUSCAT in order to simulate dust emission (in case of fulfilled emission conditions), transport and deposition. So MUSCAT gets new meteorological information every 80s model-time.

Additional, dust layers within the mid-troposphere overlay the moist and denser monsoon air and reaches higher transport levels in summer than in winter when the dust layer is transported within the trade winds (Kalu, 1979). Should be additionally

done

The present modelling study show a part of Bodele from up to 50the Cape Verde Archipelago. ???

This sentence is now rephrased.

exemplarily is consistently used to mean as an example. The most common usage of exemplarily is outstanding if I check my websters dictionary. Only the third definition is that it is used as an example. Please use as an example instead.

Thank you for your explanations. We changed "exemplarily" to "an example"

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 16061, 2008.