The authors thank the reviewer for constructive comments and suggestions. The manuscript was revised as advised by the reviewer.

General comments

The authors state that "satellite observations have difficulty distinguishing between different aerosol species…".This statement is too general and an oversimplification. Several satellite products exist which provide information on dust aerosol. Rather than completely discarding these products, the authors should apply some of these available datasets to their test cases and discuss potential limitations and the range of uncertainty of the observations. MODIS Deep Blue provides separate AOT for dust and fine mode/mixed aerosol, particle size information (via the Angstrom parameter), and single scattering albedo for dust. MODIS DB also remedies the limitation of MODIS retrieval over bright land areas such as deserts, which was mentioned as a concern by the authors. MISR provides (within some limitations, e.g. cloud cover issues) information on aerosol composition as well as height. The current perational MISR aerosol product (Version 22) reports the fraction of non-spherical particles retrieved over both land and water.
A recent relevant publication which discusses the application of MISR data to dust is: Olga V. Kalashnikova, Michael J. Garay, Irina N. Sokolik, David J. Diner, Ralph A. Kahn, John V. Martonchik, Jae N. Lee, Omar Torres, Weidong Yang, Alexander Marshak, Sero Kassabian and Mark Chodas, "Capabilities and limitations of MISR aerosol products in dust-laden regions", Proc. SPIE 8177, 81770O (2011); doi:10.1117/12.897773

Answer: The statement about satellite products are revised in the end of section 1, section 2.3 and section 4.1. The above mentioned reference is added to section 4.1.

Contrary to the authors' statement that "CALIPSO will provide layered data of aerosol properties" (p. 26501) this data is already available for some years. In addition to height-resolved information, CALIOP on CALIPSO can also measure the particulate depolarization ratio and use it to distinguish between spherical and non-spherical particles, see e.g. Yu, H., M. Chin, D.

M. Winker, A. H. Omar, Z. Liu, C. Kittaka, and T. Diehl (2010), Global view of aerosol vertical distributions from CALIPSO lidar measurements and GOCART simulations: Regional and seasonal variations, JOURNAL OF GEOPHYSICAL RESEARCH, 115, doi:10.1029/2009JD013364.
MPLNET also provides layer information for aerosols. These datasets could be used by the authors for a vertical analysis of their model results. But this aspect could also be subject of a follow-up publication.

Answer: we modified the statement about CALIPSO data.

Although it is correct that "there is no direct measurement of aerosol size distribution on a global scale" (p. 26501), there is no reason not to use size information which was derived via retrieval algorithms.
It is not clear to me why Aeronet has not been used in this paper. Aeronet (version 2) provides AOT, and via inversion techniques (under some assumptions) also size distribution, SSA, sphericity, and asymmetry factor; data on retrieval quality (for error estimation) is also provided, as well as the radiative forcing at TOA. These quantities could add a lot of insight to this study.

Answer: AERONET inversion data is added in section 3.2 for comparison of aerosol volume-size distributions. AERONET AOD data is added in section 4.2 for comparison with modeled AOD in "dusty" sites. A further investigation into the radiative quantities (such as SSA etc.) will be conducted in a future study.

If the authors have specific reasons why none of these products can be used to evaluate the model results, they should discuss this in some detail. They should then also discuss why they chose the MODIS/MISR dataset from van Donkelaar et al..

Answer: the combined dataset from van Donkelaar et al. (2010) complements to the individual MODIS and MISR dataset. We modify the description of different satellite products used in section 4.1.

AERONET AOD comparison is added in section 4.2 in the revised version at "dusty" sites. Dust AOD from other studies are also summarized and compared with the model results. The different datasets for AOD in the revised manuscript allow to robustly quantify

model biases in the context of uncertainties in observations.

In the current model version we did not diagnose the coarse mode AOD and the Angstrom exponent, but these quantities will be investigated in a further study focusing on the aerosol radiative calculation in model.

Specific comments:

p. 26478, l. 15: ADRF should also be listed for land+ocean, so it can be compared with other models.

Answer: we decided to list the value of dust ADRF instead of the ADRF over ocean/land and compare the model result with other studies (see table 3 of the revised version) because dust is the focus of this study. The land or ocean ADRF may be influenced by other aerosols and their comparisons may not help to verify the global dust pattern.

p. 26480, l. 13: MODIS is not mainly restricted to the ocean, it is restricted to the ocean and land surfaces which are not highly reflective

Answer: we revised the statement.

p. 26482, l.1: It appears from here that the aerosols are internally mixed in the model, but on p. 26487 l. 21 the authors explain that dust and ss are externally mixed. Please clarify. Also, according to p. 26488 l. 19, an external mixture is assumed for calculating the optical properties. How are the internally mixed aerosols converted to externally mixed ones?

Answer: both sea salt and dust are externally mixed in the model. The statement after equation (2) was misleading, we revised it as: "Fitting parameters $n_{0,i}$ and $\varphi_{0,i}$ for externally or internally mixed aerosol (with mass fraction of each internally mixed type of aerosol) are calculated…"

p. 26483, l.2: A climatological dataset from 1850 to 2005 is used for the vegetation and bare ground fraction. Wouldn't it be better to use a climatology closer to the current time? For example, the Normalized Difference Vegetation Index (NDVI) can be used as a tool to describe the

surface bareness because of its sensitivity to the vegetation cover; it is available from MODIS or AVHRR.

Answer: in the revised manuscript, we explain in more detail on the vegetation cover used in this model simulation. The AVHRR data is used to derive the potential dust source map, which is applied in combination with the bare fraction derived from current CTEM model. A discussion of the limitation of current dataset is added as well.

p. 26484, l.8: The gusty wind is generally strongly resolution dependent. Was the model run in different resolutions (at least for a short time period) to get an estimate of this effect?

Answer: For CanAM4-PAM run with resolutions of T47 and T63, the global patterns of gusty wind are pretty similar. Simulated values of gusty wind are an order of magnitude smaller than the model predicted wind speed (U and V) at surface. Gusty winds over continent are generally low as well. Thus we do not think the variation in gusty wind due to different model resolution will have a strong effect on the dust emissions.

p. 26488, l.28-30: Does that mean that the change in fluxes is computed as "case_with_aerosol - case_with_zero_aerosol"?

Answer: yes, it is.

p. 26489 l. 20: How were the emissions for BC, OC, SO2 processed for the climate run? Were they averaged over a certain time interval?

Answer: the emissions of BC, OC and SO2 are provided as annual mean input from 1979 to 2006 (see more information about AEROCOM-II HCA0 v1/v2 dataset at http://aerocom.met.no/emissions.html). They are applied at the year of CanAM4-PAM simulation for both climate run (1991-1995) and nudged run (2001-2006). No additional averaging was performed.

p. 26490: What threshold wind friction velocity are these two values (0.85 and 0.75) associated with?

Answer: the threshold wind Uth with the parameter Cu (see table 2) of

0.85 can be over 20 m/s in West Africa in JJA, but Uth is reduced to around 18 m/s when Cu is 0.75 in the same region and season. Uth is also dependent on the surface roughness and these numbers here are only for a rough estimate.

p. 26492, l. 6: There are other reasons why submicron particles are underestimated (e.g. transport or deposition issues).

Answer: we added that in the text.

p. 26493, l. 11-12: The authors should also list the correlation coefficient, bias, error (RMS), and standard deviation.

Answer: these statistical values are added in the scatter plots of the revised version.

p. 26493, l. 21: From where was the SST obtained? Which years were used to generate the climatology?

Answer: model is driven by the AMIP (Atmospheric Model Intercomparison Project) SST, which is widely used in the climate modeling community. The time period of climatology SST is from 1979 to 1995. The climate run of CanAM4-PAM in this study is for years 1991-1995.

p. 26493, l. 25: The authors should also list the correlation coefficient, bias, error (RMS), and standard deviation.

Answer: these statistical values are added in the scatter plots of the revised version.

p. 26497, l. 21: The plume over Indonesia might have been due to biomass burning activity.

Answer: we deleted this sentence since we would like to focus more on the dust aerosols.

p. 26497: Were the model results filtered in the same way as in the van Donkelaar paper?

Answer: no. the filtering done in van Donkelaar paper is mainly for assuring the quality of satellite retrievals. Model results are directly compared to the van Donkelaar dataset, similar to other AOD datasets.

p. 26500, l. 2: The uncertainty of observations are not provided in this paper. They are indeed an important aspect and should be included.

Answer: we are not aware of uncertainty estimates for the observational data which could be used for comparison with model results.

p. 26500, l. 15: It is not clear why the good agreement is mainly due to the size resolved scheme of this model. Please elaborate why you think other differences between your model and other models are not as relevant.

Answer: we rewrote this paragraph.

p. 26512: The plots are out of order. Also, 200410 to 200412 are missing.

Answer: we re-ordered the plot and indicated the reason for excluding the data in the last 3 months of 2004 in figure caption.

p. 26513: The numbers underneath the color bar look awkward. I suggest to use a vertical color bar.

Answer: this figure is re-plotted as another reviewer suggested and the color bar is removed.