Interactive comment on “Dust optical properties over North Africa and Arabian Peninsula derived from the AERONET dataset” by D. Kim et al.

Response to the comment of Referee #2

The paper discusses absorption of mineral dust as measured by AERONET sites in North Africa and Arabia. The paper seems to repeat results and methodology from previous studies, and is not ambitious in its analysis. It also features an outdated view of mineral dust optical properties in global models. The authors should make clear what is original and new in their study, and discuss in more details the local differences in mineral dust optical properties.

Main comments:

- Mineral dust absorption has been the subject of quite of few studies already, most of them using AERONET. The authors should state clearly whether this study is a simple update of existing results, or if the methodology is new. From reading the paper as it stands now, it seems the former is true. In addition, it would have been helpful to discuss differences among the 14 sites in more details. The impact, or lack thereof, of different dust sources on dust absorption is valuable information.

We thank the referee #2 for these comments. The major difference between previous studies and this one is that we applied a strict filter to extract nearly “pure” dust data from the AERONET data over the desert sites, which, as we showed in the text, often include aerosols other than dust in some seasons. Our dust filter is simple but we found that this method is highly effective to eliminate non-dust data and get a consistent result throughout season and sites.

Iron oxides content and dust absorption vary by different dust source locations. We added it in the text the similarities and differences in dust properties in different sites, for example, the characteristics in 4 sites used in detailed analysis that represent different regions of Saharan-Arabian domain.

- Page 20183, line 12, and page 20189, line 2: Most global models I know of up-graded their aerosol optical properties away from OPAC quite a few years ago now. The dataset by Balkanski et al. (2007) is popular for mineral dust in global models, and it would be interesting to compare against that dataset in this paper.

Our references (Kinne et al., 2006; Forster et al., 2007) indicate that some models use different optical properties than OPAC. But to our knowledge, many models still rely on OPAC dataset. We revised the sentences accordingly. The data in Balkanski et al. (2007) is adopted from Dubovik et al. (2002). We included this data in the revised manuscript.

Other comments:

- Page 20184, line 21: How does the AERONET retrieval algorithm decide when to use spheroids in the retrieval? In other word, how does it know it is dealing with mineral dust aerosols? If there is an automatic way, then the method should be replicated in analysing mineral dust optical properties.

AERONET INV algorithm uses mixture of spheres and spheroids (both spheres and spheroids) and it retrieves sphericity parameter that determines the relative content of spheres in the mixture. We got the clear distinction in the sphericity parameters between ALL (0.1~0.2) and DU (0.03~0.04) which is consistent with AE.

- Page 20185, line 10: If typical Angstrom exponents are between 0.2 and 0.6, and the authors use a ceiling of 0.2 to identify mineral dust, does it mean that the sites are actually dominated by species other than mineral dust, or that the assumption that mineral dust is mainly coarse mode is wrong?

No. Because we think it is RIGHT that mineral dust is mainly in coarse mode, we select AERONET data with Angstrom Exponent less than 0.2 (coarse mode dominated) as representative of dust. Using higher value of threshold Angstrom Exponent would allow more fine mode aerosols, which may not be dust, to be included in the "dust" data.

- Page 20185, line 19: The assumption that sea-salt aerosols have a negligible impact on AERONET measurements is unsupported. For island and coastal sites, it is likely that sea-salt is in fact a dominant species.

Our threshold for AOD is >0.40, according to Smirnov et al. (2002) the maximum of the AOD frequency of occurrences over open oceans ~0.06-0.07. So even for the coastal sites and Cape Verde maritime aerosol contributes much less than the dust.

- Page 20189, line 29: The sudden appearance of China is surprising. Surely it is outside of the area studied.

China is outside of the study region however it may be worthy to consider if the method in this study can be applied to other regions also suggested by reviewer #1. Unfortunately we did not find any AERONET site in Asia that could pass our "pure" dust filter.

Technical comments:

- Page 20182, line 14: "the previously" should read "previous".

Fixed.

- Page 20188, line 14: "that the" should read "the".

Fixed.

References:

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Dubovik, O., et al. (2006), The application of spheroid models to account for aerosol particle nonsphericity in remote sensing of desert dust, J. Geophys. Res., 111, D11208, doi:10.1029/2005JD006619.

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Forster, P., et al. (2007), Changes in Atmospheric Constituents and in Radiative Forcing, in: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, edited by: Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K. B., Tignor, M., and Miller, H. L., Cambridge University Press, Cambridge, UK and New York, NY, USA.