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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Estimation of mineral dust longwave radiative forcing: sensitivity study to particle properties and application to real cases over Barcelona" *by* M. Sicard et al.

Anonymous Referee #3

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This paper deals with SW and LW radiative calculations applied over Barcelona. The paper is very interesting and well written. The sensivity study (Fig 7 and discussion) and comparison with CERES (Fig 8 and discussion) are especially impressive.

My main suggestion for improvement is a more comprehensive review and comparison with existing literature. Some references are given but many of them are not discussed. In addition to the references given by another reviewer, I would recommend that references (and discussion where possible) are included of the following papers (AND references therein):

Balkanski, Y.; Schulz, M.; Claquin, T. & Guibert, S. Reevaluation of Mineral aerosol radiative forcings suggests a better agreement with satellite and AERONET data Atmos. Chem. Phys., 2007, 7, 81-95

Highwood, E.; Haywood, J.; Silverstone, M.; Newman, S. M. & Taylor, J. Radiative properties and direct effect of Saharan dust measured by the C-130 aircraft during Saharan Dust Experiment (SHADE): 2. Terrestrial spectrum J. Geophys. Res., 2003, 108, 8578

di Sarra, A.; Biagio, C. D.; Meloni, D.; Monteleone, F.; Pace, G.; Pugnaghi, S. & Sferlazzo, D. Shortwave and longwave radiative effects of the intense Saharan dust event of 25-26 March 2010 at Lampedusa (Mediterranean Sea) J. Geophys. Res., 2011, 116, D23209

Zhang, L.; Li, Q. B.; Gu, Y.; Liou, K. N. & Meland, B. Dust vertical profile impact on global radiative forcing estimation using a coupled chemical-transport-radiative-transfer model Atmos. Chem. Phys., 2013, 13, 7097-7114

Zhao, C.; Liu, X.; Ruby Leung, L. & Hagos, S. Radiative impact of mineral dust on monsoon precipitation variability over West Africa Atmos. Chem. Phys., 2011, 11, 1879-1893

Yu, H.; Kaufman, Y. J.; Chin, M.; Feingold, G.; Remer, L. A.; Anderson, T. L.; Balkanski, Y.; Bellouin, N.; Boucher, O.; Christopher, S.; DeCola, P.; Kahn, R.; Koch, D.; Loeb, N.; Reddy, M. S.; Schulz, M.; Takemura, T. & Zhou, M. A review of measurement-based assessments of the aerosol direct radiative effect and forcing Atmos. Chem. Phys., 2006, 6, 613-666 (especially the references given in section 4.1 of this paper)

With respect to 'rather complete review of MD microphysical and optical properties', I recommend inclusion of (if the authors deem these appropriate - and see also references in these papers):

Ahmed, A.; Ali, A. & Alhaider, M. Measurement of atmospheric particle size distribution

during sand/duststorm in Riyadh, Saudi Arabia Atmos. Environ., 1987, 21, 2723 -2725

Gu, Y.; Rose, W. & Bluth, G. Retrieval of mass and sizes of particles in sandstorms using two MODIS IR bands: A case study of April 7, 2001 sandstorm in China Geophys. Res. Lett., 2003, 30, 1805

Reid, J.; Jonsson, H.; Maring, H.; Smirnov, A.; Savoie, D. L.; Cliff, S.; Reid, E.; Livingston, J. M.; Meier, M. M.; Dubovik, O. & Tsay, S.-C. Comparison of size and morphological measurements of coarse mode dust particles from Africa J. Geophys. Res., 2003, 108, 8593

Laskina, O.; Young, M. A.; Kleiber, P. D. & Grassian, V. H. Infrared extinction spectra of mineral dust aerosol: Single components and complex mixtures J. Geophys. Res., 2012, 117, D18210

Chou, C.; Formenti, P.; Maille, M.; Ausset, P.; Helas, G.; Harrison, M. & Osborne, S. Size distribution, shape, and composition of mineral dust aerosols collected during the African Monsoon Multidisciplinary Analysis Special Observation Period 0: Dust and Biomass-Burning Experiment field campaign in Niger, January 2006 J. Geophys. Res., 2008, 113, D00C10

Sokolik, I.; Andronova, A. & Johnson, T. C. Complex refractive index of atmospheric dust aerosols Atmos. Environ., 1993, 27, 2495-2502

Sokolik, I. & Toon, O. Incorporation of mineralogical composition into models of the radiative properties of mineral aerosol from UV to IR wavelenghts J. Geophys. Res., 1999, 104, 9423-9444

Balkanski, Y.; Schulz, M.; Claquin, T. & Guibert, S. Reevaluation of Mineral aerosol radiative forcings suggests a better agreement with satellite and AERONET data Atmos. Chem. Phys., 2007, 7, 81-95

Claquin, T.; Schulz, M.; Balkanski, Y. & Boucher, O. Uncertainties in assessing radiative forcing by mineral dust Tellus B, 1998, 50, 491-505

Minor comments:

Page 8535, line 17: revise (english)

Page 8535-8536: I suggest to remove the entire discussion of sea salt. I think it is not needed and out of the scope of this paper. This space would be better used to review literature on dust.

Page 8541, line 7: aerosol cooling effect: cooling of what? surface/atmosphere/Earth?

Page 8542, line 17: 'refined compared' this is unclear, please revise

Page 8545, line 7: 'aerosol emission'. This is correct but has not been mentioned before. Please explain.

Page 8545, line 13: 'the more radiation will be reflected'. I think this is not true. In my opinion, what is seen here is a temperature effect. The lower the aerosol layer, the higher its temperature, and therefore the higher its emission.

Page 8550, line 14: the total atmospheric forcing. What is the physical meaning of this? Can this be measured? Please explain the importance of this quantity in some detail.

Page 8551: It would be nice if the discussion on heating/cooling rates would be expanded. Can you explain why the peak of the SW heating rate is at such high altitude? (given that most dust occurred below 6 km?) Perhaps it is worth adding averaged dust profiles (if available).

Figures: Another reviewer made a comment that the paper is also on the SW effect. I think it would be a great shame to remove all SW info from this paper. On the contrary, where possible I would expand the discussion to include SW (e.g. to show in figure 5 and figure 6 also to the SW part of the spectrum.). Perhaps the sensitivity study (Fig 7 and discussion) can be expanded to include an extra figure for the SW?