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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.

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This paper presents radiative effects of mineral dust aerosols observed over Barcelona as to various parameters affecting the radiative transfer in an aerosol-loaden atmosphere. I would like to give some comments on it:

1) p 8535, l 6-11: I think the opposite is the case: The most crucial point for aerosol radiative transfer calculations is the complex refractive index. In particular, for dust such data are mainly given in the thermal spectral range as Otto et al. (2009, 2011) explicitly point out. These authors stressed the need for more detailed data "in the solar

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spectral range and for further minerals". Thus, in the thermal range there is a series of more recent works on dust microphysical properties and radiative effects (Otto et al., 2007, 2011; Hansell et al., 2010; Haywood et al., 2011; Köhler et al., 2011; Osborne et al., 2011; and papers cited therein).

2) p 8535, l 20-22: Terms like "small" and "very" are quite relative. What size do you mean exactly? I suggest to discuss in more detail the results of the field experiments like SAMUM-2 and FENNEC (see, e.g., Weinzierl et al., 2011 and Ryder et al., 2013a,b) here, e.g., how large the particles can be. The size of the particles transported over long distances is very important. In this regard it should also be mentioned up to which particle size the applied size distributions are integrated to calculate the optical properties. This could also be discussed in Section 2.3 in retrospect to the Introduction and to the role of "large" dust particles. For example, in the papers of Otto et al. "large" means particle diameters larger than about 3 microns.

3) p 8536, l 25-26: Otto et al. (2011) state that the non-sphericity can have an radiative impact of about 10 % to the forcing in the thermal range. It may be significant. But to deal with non-spherical particles means big computational effort (see, e.g., Otto et al., 2009). So it is still reasonable to consider spherical particles, if no further information with respect to the shape are available.

4) p 8537, l 6: What does "good" mean?

5) Section 2.2: The authors use AERONET remote sensing products. This is, of course, the only they can do, if no other microphysical particle information are available. However, I would like to stress that size distribution retrievals of mineral dust are problematic: In a row of papers it is reported that the AERONET size distributions might misinterpret the lower number of "large" dust particles as a higher number of accumulation mode particles (Otto et al., 2007, 2009; Müller et al., 2010a,b, 2012). In summary, the AERONET distributions might underestimate the presence of giant particles and, by the way, this also corresponds to cut-off effects (Otto et al., 2011), which

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both may lead to misinterpretations. One has to keep in mind this when using retrieval products of mineral dust, in particular with regard to the importance of coarse mode particles.

p 8539, l 17-20: Please specify in detail the used distribution parameters so that the reader is able to re-calculate your results. A table would be nice.

6) p 8540, l 23: 40 layers are not much but ok. Is a constant vertical resolution chosen or does it change with altitude?

7) p 8542, l 3: Would it be possible to present the coefficients a_i and k_i as a function of p and T as supplement? Then the reader would be able to re-consider your transmission parameterisation.

8) Section 3.1: The gas absorption is parameterised by the k-distribution method which refers to "bigger" spectral bands. How did you calculate (numerically integrate) the spectrally averaged optical properties of the dust aerosol?

9) p 8542, l 22: 20 cm-1 is not "high" in my opinion but ok. For instance, Otto et al. (2011) use a 1 cm-1 resolution for their forcing calculations.

10) Section 3.2.2: For which area are the applied data representative? This point should be discussed more critically and can also be seen in connection with the question to which scenario the cases refer, a rather ocean or land case? The value of 0.017 of the surface albedo is very low which is quite typical for an ocean surface (see, e.g., Fig. 3 in Otto et al., 2011).

11) Section 3.2.2: Does CERES really "measure" the surface albedo or temperature? I think it would be better to write that these quantities are "derived"?

12) Section 3.2.3: It would be interesting for the reader to get an impression of the vertical structure of the observed dust plumes. Would it be possible to add a figure of all vertical profiles of the number concentration of all cases applied?

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13) Section 4: Most of the results presented here are not knew. That's why they should be discussed in the context of former works (see, e.g., the reference list of this review). The various investigated cases should also be motivated more clearly why they could be of interest. In particular, the role of coarse mode dust particles was recently stressed by the authors of Otto et al. as well as McConnell/Ryder et al. However, former works of d'Almeida, Tegen and Sokolik et al. (cited therein) also showed their impact on the optical properties and forcings.

14) Section 5: Against the background that satellite products refer to relatively large surface areas, how representative are they and for which scenario (see also point 10 of this review) do they stand? The title of this paper is "... over Barcelona" which refers to a land surface. This could be misleading, since a rather mixed area of land and ocean was the case. To avoid confusions, the title could be changed a little accordingly?

15) Section 5: In this section also SW calculations appear in the discussion. But in the previous sections only the thermal spectral region was of interest and in the title it is said of "longwave radiative forcing". Either the title is chosen in a more general way, but then the refractive indices, optical properties and so on must be discussed also and in more detail in this spectral range in the Introduction and Sections 2 as well as 3 which means an extension of the paper, or this spectral part is not discussed. The SW consideration seems to be only additional at the moment. If it is considered, it is definitely of interest what values of, e.g., the single scattering albedo was applied, since the coarse mode dust particles affect this quantity and thus the radiation budget extremely (in this regard keep in mind point 5 of this review).

16) p 8549, l 7-24: Based on the sensitivity studies in Section 4 it would be of interest what basic properties might lead to this or that forcing. In other words, the results here should be interpreted also in retrospect to the findings of Section 4.

17) p 8550, l 4-11: This statement assumes that the retrieval procedures result in physically correct and realistic optical properties. With regard to point 5 of this review

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it might also be the case that retrievals underestimate the coarse mode and hence the SW absorption by a too high value of the single scattering albedo. This could then lead to misinterpretations as mixtures come into play. One has to be careful here.

18) Conclusions: As in point 5 the SW properties are also discussed here although the paper is actually about the thermal part only. Why this?

19) Last paragraph of the Conclusions: The spatial variability of the dust plumes is stressed here. That's why point 12 of this review seems to be highly relevant to me to point out how variable the observed plumes really are.

20) The terms "shortwave" and "longwave" are relative. It is better to refer to the sources to indicate the spectral regions. "shortwave" –> "solar" and "longwave" –> "thermal" or "terrestrial"?

In general, this paper is based on a variety of measurements at various observed dust events in order to calculate radiative effects. Its title contains the word 'longwave' but, with respect to the results, it is also about effects in the solar spectral range, while the microphysical and optical dust properties are not discussed in this spectral range. Thus, I suggest to restrict the paper only to the thermal region of the spectrum or to extend it in all parts of it by discussions of solar properties. In both cases, however, I recommend it to be published in ACP and hope that my comments might help the authors to improve it here and there.

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