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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol radiative forcing during African desert dust events (2005–2010) over South-Eastern Spain" *by* A. Valenzuela et al.

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The paper addresses the shortwave radiative forcing of Saharan mineral dust, one of the most important atmospheric aerosols on the radiative balance of Earth-atmosphere system. The paper is well structured, clear and concise. The main concern is that the results of radiative forcing and efficiency do not justify a discussion according to source regions of Saharan mineral dust. The radiative forcing values obtained for each region are not significantly different, i.e., the mean values of a sector are within the uncertainty limits of any of the other two sectors. For example, the Table 2 and Figure 3 clearly show no significant differences among regions. Therefore, the authors should apply statistics tests (non-parameter tests like Mann-Whitney, Kolmogorov-Smirnov,. . .) that support whether there are significant differences among regions or the discussion in

reverse, i.e., the differentiation by origin observed in the radiative properties of North Africa mineral dust does not translate into radiative forcing and efficiency.

I suggest this paper may be suitable for publication after major revisions regarding this issue and the specific ones listed below.

Some minor comments:

1) Section 3.1: This study is mainly supported in the division in sources regions of Saharan mineral dust. So, please, the authors should include an explanation more in details of the methodology used to select days with mineral dust. The authors properly reference the papers that support this classification, but a brief explanation of the methodology used would complement this work. Furthermore, it would be interesting a summary with the radiative properties for each sector and an explanation of meteorological transport in the region.

2) Section 3.2: It is necessary an explanation more in detail of the methodology used to calculate the radiative forcing. For example: a) Throughout the text it is not clear how the authors calculated the mean radiative forcing values for each region. As shown in Figure 3, it is necessary to take into account the behavior with the solar zenith angle, so that the forcing must be calculated daily integrating over the solar zenith angle. Furthermore, the daily averages of aerosol radiative forcing are more climatologically significant, especially for evaluating climate aerosol effects and comparing to other studies. Therefore, please consider to calculate daily values instead of instantaneous ones. b) The radiative forcing is calculated using spectral values of AOD, ssa, asymetry factor, etc., but the authors do not mention how these values are obtained outside the spectral range 440-1020 nm (inversion range). For example, are they extrapolated at a constant value? c) The surface albedo is a crucial parameter for assessing the radiative forcing, especially at TOA. So, please justify the value set at 0.15.

3) Section 4: a) A division of this section into subsections would help to readers. For example, 4.1: Comparison between model and measurements, 4.2. Radiative Forcing

; 4.3: Radiative Forcing Efficiency or something similar. b) La comparison between simulations and measurements (CM-11 pyranometer) is quite satisfactory, but why was not it performed in the same spectral range? The difference is less than 1%, but it is an additional uncertainty. Is there any difference in comparing between clean and dust situations? c) It would be convenient that the authors discuss the scatter observed in the radiative forcing, especially at TOA (Figure 4). d) It is interesting to discuss what component of solar radiation is more affected by mineral dust. Nonetheless, the discussion of Table 1 in clean and dust conditions is equivalent to the discussion of radiative forcing. Please, consider to calculate radiative forcing by component (direct and diffuse). Exclude table 1 or modify it in terms of radiative forcing. e) The radiative efficiency is calculated by the slope method, but the figure 4 only shows the slopes and not the bias and the respective errors. The bias can give us an estimate of radiative forcing error. f) Justify the limitation of the study at solar zenith angles lower than 65 $^{\circ}$. g) Clarify in which conditions is performed the comparison with AERONET data (for example, the solar zenith angle). h) In general, many values are given without error bounds. For example, ssa, AOD, etc. Furthermore, the authors do not clarify what error type is been providing (standard error of the mean or standard deviation of the distribution).

Figures and Tables: 1) Table 3: In order to properly compare the studies given in table 3, some additional details should be added. For example, instantaneous (solar zenith angle range) or daily values, wavelength used to calculate the radiative efficiency,... 2) Figure 2: Include the error bars. Furthermore, a subplot with the monthly evolution of AOD and ssa would support the discussion. 3) Figure 3: Include error bars and the y-label. 4) Figure 4: Correct legend

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