

Atmos. Chem. Phys. Discuss., referee comment RC1  
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## Comment on acp-2021-419

Anonymous Referee #1

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Referee comment on "Aerosol radiative impact during the summer 2019 heatwave produced partly by an inter-continental Saharan dust outbreak – Part 2: Long-wave and net dust direct radiative effect" by Michaël Sicard et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-419-RC1>, 2021

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The presented paper is the companion paper of Córdoba-Jabonero et al. (2021). It is focused on the characterization of atmospheric dust properties and on the net and longwave radiative effect of that dust during a mega-heatwave at Barcelona (23 to 30 June, 2019) and at Leipzig (29 to 30 June, 2019). Authors use polarized multi-pulse lidar measurements and AERONET products to determine the microphysical dust properties and a Mie code to obtain the radiative properties in the longwave range. GAME radiative transfer model is used to study the radiative effect of the detected coarse and fine dust. They also test the impact of the extreme local surface temperature and the temperature of the dust layer on the dust radiative effect. This paper fits with the scope of the journal and the obtained results are interesting for the scientific community, hence, I recommend its publication after minor corrections.

Minor comments:

P2L59: "classified as mega-heatwave by some authors", please, cite these authors.

P3L89: "OLR of -0.8 % and a root mean square error of 2.52 W m<sup>-2</sup>." Could be added the RMSE in %, or the bias in Wm<sup>-2</sup>?

P3L96: Why LW is calculated only between 5 and 19? The Earth is emitting LW also at night-time. That is the weakest point of this work. It is mentioned that GAME cannot be used to calculate radiation fluxes at night-time (P8L223), but the contribution of dust to radiative forcing at night-time is also important. It is not clear how the daily DRE\_LW and

DRE\_SW values are calculated. The manuscript seems to indicate that these daily averages are obtained by averaging all the DRE values available in a day, that is, the values obtained only during the hours of sunshine (daytime). The DRE\_SW values at night-time (values equal to 0) should be included in the calculation of the average of the daily DRE\_SW. In addition, the daily DRE\_LW averages should be also calculated taking into account night-time data. The authors should clarify how they calculate the DRE daily averages and try to add night-time values if they are not included.

Discussion about Figure 2: The fine radius is reduced with time while the coarse one increases. Authors mention the "aerosol aging" and the "Secondary aerosol formation is enhanced in stagnant" as possible phenomena behind this behaviour. The geometric median radius and standard deviation were assumed equal to the retrieved by AERONET. These retrieved values are for all aerosol in the atmospheric column, not only dust, hence the presence of other aerosols could also modify the fine and coarse radius that are assumed for dust in this work. Changes on the other aerosols could be partially responsible of the observed changes in fine and coarse radius. Authors should take this issue also as a possible source of uncertainty, since the obtained results could be affected by the variation caused by these other aerosols (the retrieved radius and standard deviations at the column should not exactly be the same for the dust). Regards the uncertainty on the aerosol properties and the obtained radiative ones, could be helpful to quantify how they are propagated in the radiative transfer simulations in order to provide a confidence interval in the obtained DRE results.

P7L204: Why surface albedo at Leipzig is assumed equal to Barcelona albedo? Is it possible to estimate the climatological value of albedo at Leipzig as in Barcelona?

Figure 10. Y axis must be changed by the represented magnitude with its units.

P14L398: Please, remove "!".

P18L515: DRE\_LW << DRE\_SW, both terms should be marked as absolute values.

Section 3.2. Authors study the effect of the heatwave (high temperature at surface and at dust layer) on the DRE. But DRE also affects to the heatwave analysed parameters (surface and atmosphere temperatures), which affects to DRE, and changes on DRE affects again to temperature and again and again... Could be discussed if there are any positive or negative feedback process between DRE and heatwave? It is interesting to know if the intrusion of dust during a heatwave helps to mitigate this heatwave or on the contrary it enhances heatwave temperatures.