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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Coarse and Giant Particles are Ubiquitous in Saharan Dust Export Regions and are Radiatively Significant over the Sahara" *by* Claire L. Ryder et al.

Anonymous Referee #3

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This is overall an excellent paper that draws on previously published work to review the contribution of coarse dust to the dust loading and extinction in and near the Sahara. This paper will be a valuable addition to the literature.

The authors report some impressive findings of the contribution of coarse and giant particles to mass loading and extinction, particularly over the Sahara. These particles seem to account for much more of the dust loading and SW and LW extinction than realized or accounted for in models, so this is important. But if I'm not mistaken, all the observations used were taken during the summer months. Because convection is stronger in those months, dust layers are higher, and coarse dust can be expected

to be a larger fraction of the dust loading than in winter months. This is for instance shown explicitly by surface observations in Van der Does et al. So it's important that the authors emphasize either that their findings apply to the summer months, and/or that their findings would be an upper limit for the annually-averaged contribution of coarse dust. Currently, that's not clear.

Further comments:

- The abstract is clear but very long (∼400 words), so I'd recommend shortening to make the main findings easier to absorb.

- The D_max metric is defined as the largest bin for which >4 particles were detected during a flight leg. This seems a bit problematic as it depends strongly on instrument sensitivity and flight duration. This makes it difficult to interpret and also difficult to compare between different observations with different flight durations or instruments, which the authors acknowledge on p. 10. Perhaps a metric like the 99th percentile of the cumulative mass distribution would be more meaningful and useful?

- Similar to many previous studies, the authors assume that dust is spherical for calculations of optical properties. That's reasonable, but considering that dust is quite aspherical, they should include a few sentences on how they expect their results to change if they had accounted for dust asphericity.

- Line 4, p.2: There's a wide range of estimates of annual dust emissions, so 1,100 Tg/year is too precise a number. More importantly, the dust size range to which this number applies should be included, especially considering the topic of the article.

- Line 7, p. 18: The authors here seem to confuse radiative forcing and radiative effect. See for instance Heald et al. (2014). The authors seem to allude here to the dust radiative effect, which is the net effect on the climate of dust interactions with radiation. The IPCC report calculated the radiative forcing, which is the change in that radiative effect. Please correct accordingly.

- Figure 4: It's not clear to me why this figure does not include results from FENNEC SAL?

- Figure 7: The vertical axis "% contribution" is only meaningful if the spacing of each bin is provided. I recommend changing this axis to something meaningful like "% contribution per ln D (or dQ/dlnD)". Same comment for Fig. 9. Also, I'd suggest adding the titles "Extinction" and "Absorption" to panels b and c.

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