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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Optical properties of Saharan dust aerosol and contribution from the coarse mode as measured during the Fennec 2011 aircraft campaign" *by* C. L. Ryder et al.

Anonymous Referee #1

Received and published: 5 December 2012

The manuscript reports on new evidence on the role of the coarse mode of mineral dust aerosol in determining the optical properties of that aerosol. Neglecting very large aerosol particles leads to an underestimation of absorption by the aerosol layer and hence to an inaccurate assessment of its radiative impact. This is particularly true near the sources of the dust aerosol, where large aerosol particles are more abundant than generally assumed. That assumption is largely due to the extreme scarcity of observations in the remote regions in the Sahara; and the observations themselves often suffer from technical problems of actually sampling the entire size distribution. Inlet characteristics often cut off a large fraction of the coarse mode. The presented manuscript focuses on this problem and presents measurements and analysis of dust aerosol

in Mali and Mauritania, in the direct vicinity of dust sources. The Fennec campaign managed to come even closer to the source than SAMUM-1 and therefore provides valuable data. Given the geopolitical situation in that region, we must be very happy that such data have been made available. The authors motivate their study well, and I recommend publication with minor modifications as outlined below.

General comments:

- The terms "longwave" and "shortwave" have several meanings, depending on who you ask; "solar" and "terrestrial" should be preferred.

- Adjectives like "northern", "southern", "central" are not capitalised unless part of the name of an actual entity. For example, "East Anglia" and "North America" and "Western Sahara" refer to geopolitical territories with fixed boundaries, while "northern Mauritania" and "central Algeria" and "western Sahara" refer to roughly delineated parts of something bigger.

- You define the refractive index as m = n + ik. Then it does not make sense to refer to the imaginary part as k = 0.001*i. k should not include the i, as then m would become a non-complex real number. In the manuscript, k sometimes includes the i and sometimes it doesn't.

- For consistency, a few occurences of "color" should be changed to "colour".

Specific comments:

P.26786, line 1: Is there maybe a more recent citation?

P.26787, line 18: "Fennec represent significant advances": Avoid teasers, simply state that Fennec provided additional coverage in certain parts of the western/central Sahara.

Section 2.2.2, last sentence: Please explain your reasoning in a little more detail.

Section 2.2.3: After reading the first paragraph, I would have expected to first find

a comparison of the three size distributions as simultaneously observed by the three OPCs. For instance, one of the Rosemount OPCs could be added in Figure 3 to show the cut-off effect of such an inlet.

Section 2.3, second sentence, "the size measurements here have been corrected for refractive indices typical of dust": The wording implies that the sizes are first retrieved for some default refractive index, and then they have to be corrected for a given different value of the refractive index. Is that so or do you feed the dust index directly into the size retrieval from the onset?

Section 2.4, first sentence: The manuscript is already full of acronyms of instruments and campaigns that can hardly be avoided. I did not remember at this point what an SLR is. I would recomment to avoid 'lab slang' acronyms in a publication if the reader might be overwhelmed by so much capitalised material.

Page 26800, line 19: This procedure sounds more like a look-up table than an iteration.

Section 2.7: Is any attempt made to relate the refractive indices to source regions?

Section 2.8, first sentence: The measurements do not affect the heating rates; rather say "impact of the aerosol size distribution on solar heating rates".

Line 11: A spectrally constant surface albedo of 0.4 is pretty high even in the Sahara, especially at visible wavelengths. While I understand the authors' approach to simplicity in the radiative transfer model, they must be aware that a high surface albedo amplifies the effect they are looking for, as photons are much more likely to 'get a second chance' of being absorbed by the aerosol and to heat the layer.

Line 12: With the solar zenith angle fixed at zero and Table 5 giving heating rates in Kelvin per day, I assume the model depicts a planet where the Sun is in the zenith 24 hours a day. If so, the absolute numbers are so unrealistic that I would refrain from calling them heating rates, or at least from giving them 'per day', as they might erranously be compared to values in other publications that take the diurnal cycle into

account.

Page 26806, line 20: "densest"

Page 26811, line 10: PSAP, not psap

line 11: characterised

Page 26812, line 25: extended to

Page 26813, line 2: replace 'incredibly' by something scientific

Page 26814, line 7: will provide

Page 26815, line 14: In reality, dust aerosol particles are non-spherical,

References:

Please add umlauts as in the original citations (Dornbrack, A.; Muller, D.; Muller, T.; Schutz, L.)

Please update the status of the many references that are 'in press', 'submitted', or 'in preparation'

Technical notes, Trembath and Turnbull: are those available anywhere outside FAAM/MetOffice?

Figures:

Please adjust the font sizes of axes, tick marks, etc., to a fixed size for all figures regardless of how many are stacked together. Figs. 7, 10, and 11 are pretty much illegible.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 26783, 2012.