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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.

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We thank the referee for their comments and suggestions. Please find responses to specific points below.

General comments:

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

We have clarified the terms by stating both 'shortwave' and 'solar' (or 'longwave' and terrestrial') at the first occurrence of these terms in the manuscript, and several subse-

quent occurrences.

- 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.

Corrections have been made in Table 1 ('eastern Atlantic,' 'southern Sahara,' 'southern Morocco,' 'western Mauritnaia,' 'western Atlantic') and p26787 l13 (eastern Atlantic).

- 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.

This has been corrected and 'i' removed in references to k. Where m is reported (e.g. 1.53-0.001i) the 'i' is retained.

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

Since ACP follows American spelling, we have changed occurrences of 'colour' to 'color.'

Specific comments:

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

We have added Shao et al., (2011) to this line.

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.

Some extra words have been added here to provide clarification.

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

The following sentences have been added, “This is due to the Rosemount inlet and subsequent pipework removing most of the large particles before they reached the first nephelometer. Therefore only a small fraction of particles larger than 1.5 μm remained to be removed by the impactor.”

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.

We have added extra data points to this plot to represent the size distributions at the nephelometer and PSAP, and explanatory text to section 2.2.3.

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?

The former is correct – the size bins are initially corrected for standard refractive indices (such as polystyrene latex for the PCASP and water for the CDP). Subsequently the correction for a different refractive index is performed. A sentence to this effect has been added.

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.

‘SLR’ has been replaced by ‘horizontal leg’ throughout the article.

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

In many ways this procedure is similar to a look up table. Effectively we iterate through a look-up table until agreement is found.

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

No attempt is made in section 2.7 to relate the refractive indices to source regions. Comparisons of the different cagetories’ refractive indices are examined in Section 5, p26811, lines 21-26, though different source regions do not appear to have significantly different refractive indices here. This may be because the derived refractive indices only represent the accumulation mode here.

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"

This has been changed.

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.

The values of surface albedo originally used were based on broadband radiometer measurements of surface albedo during a couple of flights. Based on figure 1 in Christopher et al., (2011), we have adjusted the broadband surface albedo used in the article from 0.4 to 0.33, which appears to be a mid value typical of Saharan North Africa. We also test uncertainties due to value of 0.2 and 0.45 as typical minima and maxima from Christopher et al., (2011). The results suggest a similar amplification in heating rate when comparing a size distribution with coarse particles (i.e. the lower SSA range) to a size distribution without coarse particles (i.e. the higher SSA range). However, the total heating rate due to dust is very sensitive to the surface albedo, with uncertainties of up to 50% due to the values tested. The above is now detailed in the

article.

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.

The values presented in Table 5 are instantaneous heating rates for an overhead sun. These have been made more applicable by presenting them in terms of Kelvin/hour. We have added the sentence, "Instantaneous heating rates for an overhead sun are calculated" to the end of this section. We also now remind the reader in section 6 that the heating rates will change during the day.

Page 26806, line 20: "densest"

Changed

Page 26811, line 10: PSAP, not psap

changed

line 11: characterised

changed

Page 26812, line 25: extended to

changed

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

The word 'incredibly' has been removed and the sentence re-worded.

Page 26814, line 7: will provide

changed

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

This sentence has been reworded

References:

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

We apologise for these errors and have corrected them.

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

These have been updated where possible.

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

Yes, the documents are available now at http://www.faam.ac.uk/index.php/component/docma science-instruments. This URL has been added to the article in the references for both documents.

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.

These figures have now been adjusted and all have larger text and tick marks.

Additional References

Christopher, S. A., Gupta, P., Johnson, B., Ansell, C., Brindley, H., and Haywood, J.: Multi-sensor satellite remote sensing of dust aerosols over North Africa during GER-

BILS, Q J Roy Meteor Soc, 137, 1168-1178, Doi 10.1002/Qj.863, 2011.

Shao, Y. P., Wyrwoll, K. H., Chappell, A., Huang, J. P., Lin, Z. H., McTainsh, G. H., Mikami, M., Tanaka, T. Y., Wang, X. L., and Yoon, S.: Dust cycle: An emerging core theme in Earth system science, Aeolian Res, 2, 181-204, DOI 10.1016/j.aeolia.2011.02.001, 2011.

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