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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Toward an Observation-Based Estimate of Dust Net Radiative Effects in Tropical North Atlantic Through Integrating Satellite Observations and In Situ Measurements of Dust Properties" *by* Qianqian Song et al.

Anonymous Referee #1

Received and published: 5 April 2018

This is a well-done and interesting article that presents what seems to be a robust analysis of the direct radiative effects of dust aerosols over the tropical North Atlantic. The authors perform a detailed analysis that combines measurements from several satellite instruments (CALIPSO, MODIS, CERES) with measurement-based estimates of dust optical properties and size distributions (from the Fennec campaign), as well as calculations with the RRTM radiative transfer model. I hope to be able to recommend the article for publication after the authors address my comments below.

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Discussion paper

- My main concern is that it is not clear how this study accounted for variation in the solar angle when calculating the DRE efficiencies. This is obviously a major factor affecting the outgoing SW fluxes, so the methodology for this should be clearly discussed.

- The title is very long. I'd recommending making it more concise to make it easier for readers to quickly comprehend what the study is about.

- It's a bit unclear to me why the authors did not use AOD retrievals from MISR, which have the advantage of also providing information the aerosol type?

- I think the years over which the analysis is performed should be noted in the abstract for clarity.

- The authors should explain their use of the term instantaneous DRE (first on line 163, I think). It's clear only later in the paper that this is meant to distinguish what they measure / compute from the diurnally-averaged DRE. As such, it seems to deviate from the definition as given in the fifth assessment report, so that authors should clarify this.

- Lines 334-335: Please be more specific here. Exactly which atmospheric profiles did you use? Ozone, water vapor, other greenhouse gases? Did this account for any fractional cloud cover of optically-thin clouds?

- The errors are alternately reported as 1 sigma and 2 sigma intervals. I recommend the authors choose one and keep this consistent to avoid confusion.

- I understand and appreciate that you report both the MODIS and the CALIPSO-based estimates of the DRE and the DRE efficiency. However, it's clear that the MODIS estimate is likely to be more accurate. I think your paper would therefore have more impact if you combine these estimates into a single number, either by using error propagation to weigh each estimate proportional to the inverse squared of their error; this will weigh the estimate towards the lower-error MODIS-based estimate.

- Line 378: Could you include the exact definition of the extinction efficiency here, which differs somewhat between different sources? Is this the extinction cross section normalized by the projected surface area of the irregular dust particle, or normalized by the projected surface area of the volume-equivalent sphere? Additionally, please clarify how the extinction efficiency is actually calculated for the mixed size distributions of Fennec and Aeronet.

- Line 379: Please clarify what the physical reason is that causes a higher extinction efficiency for the Fennec size distribution.

- Table 3: Please include here the LW DRE efficiency (based on 0.5 um AOD), as you did for your SW results, which is easier to compare between studies.

- Lines 591 – 612: These two paragraphs compare their results to other studies. As such, this really belongs in your discussion section, not your conclusion section.

- Figure 3: Please include a, b, c, d labels. Also, the reference is Di Biagio et al., 2017 (not 2016).

- Figure 4a: Please include labels on your horizontal axis. Currently, the numbers are not clear.

- Figure 8: It's confusing here that the red and blue dashed lines, which denote model calculations with particular microphysics, have the same color as the observation-based lines. Please adjust.

Overall, congrats on a great article!

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