

Atmos. Chem. Phys. Discuss., referee comment RC1
<https://doi.org/10.5194/acp-2021-275-RC1>, 2021
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Comment on acp-2021-275

Michael Jensen (Referee)

Referee comment on "Sunlight-absorbing aerosol amplifies the seasonal cycle in low-cloud fraction over the southeast Atlantic" by Jianhao Zhang and Paquita Zuidema, Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-275-RC1>, 2021

Review of "Sunlight-absorbing aerosol amplifies the seasonal cycle in low cloud fraction over the southeast Atlantic," by J. Zhang and P. Zuidema submitted for publication in Atmospheric Chemistry and Physics.

This manuscript builds on the authors' work published in 2019 and presents results from the analysis 8 months (July-October 2016, 2017) of observations of aerosols, clouds and environmental conditions to investigate the interactions of frequently occurring smoke particles and low-level cloudiness in the Southeast Atlantic. An important component of the analysis is a breakdown to subseasonal (monthly) timescales which allow consideration of the variability in boundary layer structure due to large-scale meteorological influences. The important results of this work quantify the influences that smoke, transported from the African continent, has on the seasonal evolution of cloud properties. The manuscript represents an important contribution to the field and is well-written. I do believe that there are a few minor issues and edits that should be made for improved clarity before the manuscript is published in Atmospheric Chemistry and Physics.

Minor Comments:

Lines 109-120 – I found this section, comparing the ACAOD, rBC mass and fine mode AOD, a little confusing to keep track. One source of confusion is the use of "These" in line 114. I think "These" refers to ACAOD and τ_{af} . I think then that the purpose is to use τ_{af} as a proxy for ACAOD such that one avoids the problems of ACAOD only being available when clouds are present. If that is the case, it would be helpful to also include joint histograms of τ_{af} and rBC. It might also be helpful to use τ_{af} on the label axis for Fig. 1 (right most panel) and in the legend for Fig. 2.

Line 165 – It is not clear how the stratiform and cumuliform classifications shown in Fig. 3b are done. Are these based on the observer reports? A radar-based classification? Or

something else? It would be helpful to clearly identify where these are coming from.

Line 180 – Here, in the discussion of Fig. 4a and later in the discussion of Fig. 5a, the cloud boundaries being higher or lower are mentioned. But this information is somewhat buried in the profiles of cloud frequency of occurrence. To help clarify these discussions, it would be helpful to provide statistics of the cloud base and top heights themselves.

Line 183 – Would suggest replacing “drizzles” with “precipitation.” The disdrometers are not very sensitive to drizzle sized droplets likely need larger precipitation drops to make a recording. If you decide to stick with drizzle, it should be “drizzle” rather than “drizzles.”

Suggested minor edits:

Line 74 – Add “rain gauge” after “tipping bucket.”

Line 80 – Add “the” before “Terra and Aqua.”

Line 113 – Add “compared to other months” after “lower.”

Line 114 – Add “a” before “3° x 3°”

Line 122 – What threshold are you using to define “high ACAOD?”

Line 125 – What is meant by “composite decisions?” Is this the determination of high or low smoke days? Would “composite classifications” be clearer?

Line 179 – It would help clarify this sentence to start with a phrase like, “For more smoky conditions...” It was not clear to me at first that this is what was being discussed.

Line 189 – “absorbing” should be “absorption.”

Line 190 – “extending through the night” suggests that shortwave absorption occurs

through during the night. I think you mean to say that the warmer sub-cloud layer persists through the night when no shortwave absorption is taking place.

Line 217-218 - The difference in the sharpness (difference from inversion base to inversion top) of the inversion is a combination of the sharpness of the individual cases, and the variability in inversion height (both base and top) across the composite population. Reporting the statistics of the inversion base, inversion top and thickness (in height, and change in temperature and water vapor) would be useful. Another way to separate the impact of the changing inversion base height is to normalize the height coordinate by the inversion base height.

Line 228 - Add "the" before "boundary layer".

Line 234/235 - Add "the" before "Ascension region."

Line 235 - "weaken" should be "weakened."

Line 237 - "is correlating" should be "correlate."

Line 248 - Same comment as that for line #217-218.

Line 249 - "an" should be "a."

Line 274/275 - With the exception of the 12-18 LST cloud frequency profile, the plot does suggest greater cloud occurrence during the less smoky cases. Have you done a statistical test to determine that these profiles are not significantly different?

Line 289 - "Offshore" is used twice. Suggest removing the first instance.

Line 294 - It would be very helpful to the reader to note the latitude of Namibia here.

Line 326 - It would probably make sense to put square brackets around [2018] here.

Line 329 – It is not clear how the profile is “bench-shaped.” Is this a term used elsewhere? If so, please provide a reference.

Line 329 – It looks like the maximum in the longwave cooling profile is $> 50\text{K/day}$ at cloud top near a height of 1.7 km? Is the 28K/day just for the smoke layer?

Line 330-331 – It is very difficult to see this difference in height of the maximum of LW versus SW cooling/heating. Adding some grid lines, or some other horizontal line to Fig. 8 would help the reader see this.

Line 336-340 – This last paragraph seems tertiary to the previous discussion and does not really add necessary support. I would suggest removing it.

Line 342 – Remove “the.”

Line 343 – Suggest “ We extend the work of ZZ19...” rather than “This extends Zhang and Zuidema (2019)...”

Line 351 – Suggest “compared to” rather than “than.”

Line 360 and line 377 – Use acronym (LWP) for liquid water path.