

Line numbers refer to the revised, marked up document with tracking, not the original revised document reviewed or the version without tracking.

Reviewer #1

I am basically satisfied with the revision. I thank the authors for including the additional analysis of the moisture fields, which help deepen the study. I have some additional minor comments listed below. The most major one is that some discussion of how the HSRL-2 derived effective radii compare to what's been reported from the field campaigns, and what it means, would be nice

Line 49: "are in" -> "include"

Line 51: other more recent modeling studies quantifying the semi-direct radiative effect include Mallet et al 2020 ACP and Solomon et al 2021 npj climate and atmospheric science

Lines 43-44. 'include' and additional reference.

Line 59-61: sentence a bit vague as written, the 3 studies cited I believe all focus on an increase in cloud cover/LWP by aerosol absorption occurring above the cloud. Aerosol embedded within the cloud layer can indeed reduce cloud cover through raising the temperature and lowering the relative humidity, shown, e.g., in Zhang and Zuidema 2019 ACP using data from Ascension Island.

Lines 56-57. Sentence added with reference to Zhang and Zuidema (2019).

Top of page 3: the way it's written is slightly confusing in that the paragraph under '2' suggests data from 3 campaigns will be used, but I think this study just focuses on September 2016, and only ORACLES data. This doesn't entirely come through.

Lines 84-85. Clarified by adding 'the deployment covered in this study'.

Line 91: add 'September' after monthly-mean

Line 88. Done.

Line 93: IOPs not defined. You could just say 'deployments', even clearer would be substituting 'for the September 2016 deployment' for 'for all ORACLES IOPs'. A basic description of the AEJ-S would also be helpful.

Lines 90-91. 'Deployments' instead of IOP and a description of AEJ-S.

Line 313: if the authors can find some particle sizes from the campaign literature to cite here that would add interest. Wu et al 2020 ACP show PCASP-derived median diameters of about 230 nm for CLARIFY and report similar values from SAFARI data on their p. 12707. Shinozuka 2020 fig 9 shows UHSAS dry mean diameters of about 200 nm for smoke layers only. They didn't do effective radius unfortunately. Do these 2 studies suggest nevertheless that the HSRL2-derived values may be biased

slightly high? The ORACLES September 2016 UHSAS and LDMA size data would be publicly available if the authors wanted to do a quick check.

Lines 267-283. A paragraph has been added along with several references regarding particle size. The HSRL-2 retrievals of SMF effective radii are discussed in the context of previous measurements and retrievals. A comparison of HSRL-2 derived particle size with in situ measurements is not straightforward since the retrieved sizes are for ambient particles whereas airborne in situ measurements are for dry aerosol.

References:

Mallet, M., F. Solmon, P. Nabat, N. Elguindi, F. Waquet, D. Bouniol, et al, 2020: Direct and semi-direct radiative forcing of biomass burning aerosols over the Southeast Atlantic (SEA) and its sensitivity to absorbing properties: a regional climate modeling study. *Atmos. Chem. Phys.*, **20**, p. 13191-13216, doi:[10.5194/acp-20-13191-2020](https://doi.org/10.5194/acp-20-13191-2020)
Solmon, F., Elguindi, N., Mallet, M. et al. West African monsoon precipitation impacted by the South Eastern Atlantic biomass burning aerosol outflow. *npj Clim Atmos Sci* 4, 54 (2021). <https://doi.org/10.1038/s41612-021-00210-w>
Wu, H., Taylor, J. W., Szpek, K., Langridge, J. M., Williams, P. I., Flynn, M., et al.: Vertical variability of the properties of highly aged biomass burning aerosol transported over the southeast Atlantic during CLARIFY-2017, *Atmos. Chem. Phys.*, **20**, 12697–12719, <https://doi.org/10.5194/acp-20-12697-2020>, 2020.
Zhang, J. and P. Zuidema, 2019: The diurnal cycle of the smoky marine boundary layer

Reviewer #2

Re-review by Reviewer #2 of: Vertical structure of biomass burning aerosol transported over the southeast Atlantic Ocean, H. Harshvardhan et al.

Most of the comments in my original review have been addressed. With just a couple small additional changes, I think the paper should be published.

Referring to line numbers in *acp-2021-846-ATC1.pdf*, which shows the tracked changes to the originally submitted paper:

Lines 56-58: This text still is misleading as it omits the DRF through light scattering. It reads: “It exerts a direct radiative forcing (DRF) on the atmosphere by absorbing the incoming solar radiation along with the radiation reflected by the underlying cloud surface (Chand et al., 2009; Meyer et al., 2013; Zhang et al., 2016).” The DRF is mostly through scattering sunlight, and I’m not sure why there’s the focus only on atmospheric absorption here. The atmospheric absorption component can be highlighted while noting by editing to, e.g.: “It exerts a direct radiative forcing (DRF) by scattering and absorbing sunlight in the atmosphere; when underlying clouds are present, these aerosols absorb the incoming solar radiation along with the radiation reflected by the underlying cloud surface.”

Lines 50-51. Sentence has been modified to read “...(DRF) by scattering and absorbing solar radiation in the atmosphere; when clouds are present, these aerosols absorb incoming solar radiation...”

Line 201: The text states that Box E is “not significantly influenced by the BB aerosol”, but I’m not sure what the basis is for this assertion. There is clearly an elevated layer of extinction at about the same altitudes as in the Boxes A-D, and with similarly aerosol characteristics (Figures 6-9). More to the point,

the ORACLES flights through the area prescribed by Box E did often measure smoke aerosol, albeit at lower concentrations than further north. Unless the authors have evidence otherwise, I think it can be stated that Box E coincides with the southern edge of the region influenced by the African biomass burning plume – but not that it is “not significantly influenced” by the BB aerosol. In fact, I’m not sure why it’s important to include Box E, though doing so isn’t a problem. As such, I think a minor edit to the above sentence is sufficient.

Line 182. Box E has been identified as being at the southern edge of the region. We would like to keep Box E.