Reviewer #1

The authors examine the extreme Saharan dust storm that occurred in 2015 with regard to emission, transport patterns and radiative impact. They further discuss the 2015 event in context of the 2020 'Godzilla' dust events.

The manuscript is well written and I enjoyed reading. The topic (extreme trans-Atlantic dust events) is well introduced and the work carried out is clearly motivated. The presentation of the study design follows a clear structure; the authors have examined diverse aspects of the trans-Atlantic dust event considering the role of dust emission (i.e. winds over dust source regions) and key elements of the atmospheric circulation (i.e., AEJ, CLLJ, NASH) and hence these elements determining the general transport pattern. They further investigate the dust radiative impact and the impact of dust aerosol on the air quality over the US. Overall, the authors present a nice case study on an extreme trans-Atlantic dust event. The discussion with regard to the 2020 'Godzilla' dust event as well as to an overview study on extreme trans-Atlantic dust events puts this study into perspective.

We thank the reviewer for the time and effort in reviewing our paper. Your insightful and constructive comments improved our paper. We reply to your comments below.

I only have a few minor comments and suggestions the authors may want to consider.

- Line 163: please introduce the abbreviation VIIRS. E.g. "(VIIRS, Hsu et al. 2019)"
  Done.

- Line 191: Banks et al. (2018) and (2019) examined in detail the impact of dust optical properties, atmospheric dust concentration, dust layer height, surface and atmospheric properties. Please consider extending the list of references.
  Done.

- Figure 3: It's somewhat challenging to read the colour underneath the filled circles (dots) which represent regions where MODIS AOD is >= 95^{th} percentile. Did you consider reducing the diameter of the dots? I am wondering if this would allow for reading both information the AOD expressed by colour and the percentile exceedance.
  We revised the figure. Now the dots are in a lower density and in blue, which can be easily distinguished from the underneath shading.

- Figure 4a: The location of AERONET stations is indicated by red dots, however, as red is also part of the colour scheme representing the number of days, I am wondering if choosing a colour which is not part of the colour shading may allow for better identification of the AERONET sites over the Western Atlantic.
  We updated the figure to change stations to black dots.

- Figure 5: Similar comment to the one made above: The inlet figure is very nicely designed and helpful to geographically the total attenuated backscatter profiles. However, as the satellite's track (red) crosses areas of high AOD (red), I am wondering if you could choose a different colour for the track.

We updated Figure 5. Now the satellite tracks are in blue.

- Figure 6: Dots represent regions where MODIS AOD is greater or equal than the 95th percentile. However, the density of the dots is rather high, which makes it challenging to read the colour underneath. Did you consider plotting the dots at a lower density which would allow reading the colour shading underneath?

  Thanks for the suggestion. We revised the figure to reduce the density of the dots.

- Figure 7: Similar to Figure 6, did you consider plotting the dots at a lower density to allow for reading the colour shading underneath?

  Figure 7 is also updated with a lower density of dots.

- Figure 10: I find it challenging to identify the hatches and bring them together to a coherent pattern. Maybe this information layer (soil water <= 5th percentile) can be indicated in a different way?

  We updated the figure to use blue circles to highlight areas with soil moisture ≤5th percentile.

References:

Banks et al. (2019), The sensitivity of the colour of dust in MSG-SEVIRI Desert Dust infrared composite imagery to surface and atmospheric conditions, Atmos. Chem. Phys., 19, 6893-6911, https://doi.org/10.5194/acp-19-6893-2019

Banks et al. (2019), The influence of dust optical properties on the colour of simulated MSG-SEVIRI Desert Dust infrared imagery, Atmos. Chem. Phys., 18, 9681-9703, https://doi.org/10.5194/acp-18-9681-2018

Reviewer #2

This paper examines an extreme dust burst and transport event in North Africa, and investigated the surface, circulation conditions that might have caused this event as well as its impacts on radiative budget and air quality. The analysis is comprehensive and the conclusions are helpful in understanding and prediction such extreme events. I think it could be a good contribution to ACP after addressing and clarifying several questions.

We thank the reviewer for the time and effort in reviewing our paper. Your insightful and constructive comments improved our paper. We reply to your comments below. Line numbers refer to lines in the revised manuscript with tracked changes.

Major comments:

1. It seems that a major goal of the study is to contrast the 2015 event with the 2020 event, to examine the similarity and differences in the causes and physical processes of these two events. However, I don't think the comparison is done thoroughly enough. The authors only provided some comparison of AOD maps in the supplementary materials. More variables and fields, such as solid condition and circulation patterns, should be contrasted. These two factors may play different roles in these two events, which could provide insights into the formation and even forecast of extreme dust outbreaks. Also, it would be helpful to provide a dust map (such as DOD, AAI or other dust related observational variables), so that these two events can be better identified and justified.

   Thanks a lot for the suggestion. We would like to clarify that the main goal of this paper is not to contrast the two events but to understand the formation and impacts of the 2015 event. When discussing the AOD features (e.g., lines 307-308, 363-365), circulation patterns (Fig. S6) and radiative (Figs. 11, S4) and air quality impacts (lines 589-592) of the 2015 event we also compare the event with the 2020 "Godzilla" event.

   Following this and the comment from Reviewer #4, we added Tables 1-2 and discussion in lines 615-618 and 627-629 to Section 4.5 to better quantify the similarities and differences between the two events. Table 1 summarizes the characteristics and radiative and air quality impacts of the two events, while Table 2 compares the land surface (10 m wind speed, NDVI, soil moisture) and atmospheric circulation conditions (magnitude of the AEJ, CLLJ, and NASH) of both events.

   In terms of dust maps, we already included MERRA-2 DOD in Figs. 1-3. Both the timing and the spatial patterns of MERRA-2 DOD are very similar to MODIS AOD, suggesting that MODIS AOD well represents the evolution of the African dust plume. We also added the DOD values of both events in Table 1 for reference.

2. It seems that the authors have analyzed many factors that could contribute to this event, but it is not clear what their respective contributions are. Could the authors provide some more quantitative results? Statistical methods such as variance analysis, partial regression might help. Similar can be done for the 2020 event so that it will be possible to better contrast the physical causes of these two events.

We follow the suggestion to use a multiple linear regression model to examine the relative contributions of surface wind speed, soil moisture, and NDVI on enhanced AOD over dust source regions in western North Africa for both events. A similar method was used by Pu and Jin (2021) for the "Godzilla" event in June 2020, and the spatial pattern of AOD anomalies in the event was largely captured. The findings for the 2015 event and a discussion of the results are added to lines 490-505.

Following Pu and Jin (2021), we first calculated the multiple linear coefficients by regressing monthly MODIS AOD in June onto standardized monthly ERA5 surface wind speed, ERA5 top-layer soil moisture, and MODIS NDVI in June from 2003 to 2022. All data are interpolated to a 1° by 1° grid before the calculation. Together, surface wind speed, soil moisture, and NDVI can explain about 64% of variances of June AOD over western North Africa (8°-25°N, 5°-18°W), similar to the finding of Pu and Jin (2022) who used surface wind speed, precipitation, and NDVI for multiple regression. We then reconstruct the anomalies of AOD using regression coefficients and standardized anomalies of surface winds, soil moisture, and NDVI over a 14-day period for each event, i.e., before the onset of the event to the early stage of the event (3–16 June 2015 and 7–20 June 2020). The results are shown in Figure S1 for the 2015 event and in Figure S2 for the 2020 event.

As shown in Fig. S1a-b, the linear model barely reproduces the spatial pattern of AOD anomalies in the 2015 event. It only shows weak positive AOD anomalies around 13°-16°N. The pattern correlation between the reconstructed AOD and MODIS AOD over western North Africa (grey box in Fig. S1) is only 0.21. The magnitude of the reconstructed AOD over western North Africa, 0.00 ± 0.11 (90% confidence intervals), is also much smaller than that of MODIS AOD, 0.11. Among the three factors, the contribution from the reduction in NDVI is the largest (Fig. S1c-e).

For the 2020 event (Fig. S2), the result is very similar to that of Pu and Jin (2021; their Fig. 9). While the linear model largely captures the spatial pattern of AOD (pattern correlation 0.86), the magnitude of reconstructed AOD anomaly over western North Africa is also much smaller than that of MODIS AOD, 0.09 ± 0.11 vs. 0.29. Both NDVI (i.e., the decay of vegetation) and the increase in surface winds contribute to the enhanced AOD. Overall, the AOD anomalies in the 2020 event are better captured by the multiple linear regression model than in the 2015 event.

Based on the results above, we added a discussion to the end of Section 4.3:

"A multiple linear regression model has been used to quantify of relative contributions of land surface variables (i.e., surface wind speed, precipitation, and NDVI) to dust emissions over western North Africa in the "Godzilla" dust event in June 2020 (Pu and Jin 2021). Here we tested the same approach but using monthly surface wind speeds and top-layer soil moisture from the ERA5 and NDVI from MODIS as explanatory variables. Similar to the findings of Pu and Jin (2021), these variables can capture 64% of the variations of June AOD over western North Africa during 2003–2022 and largely reproduce the spatial pattern of AOD anomalies in the 2020 event (pattern correlation 0.86), although AOD magnitude is underestimated. However, we found that the statistical model cannot well reproduce the AOD anomalies in the June 2015 event (pattern correlation 0.21). A few factors may contribute to this discrepancy. The much shorter duration (i.e., one day) and weaker magnitude of the dust extreme over western North Africa during the 2015 event may be harder to capture in comparison with the stronger aerosol extreme that lasted six days in the 2020 event. Mechanisms that affect dust emissions on shorter time scales (e.g., from sub-hourly to daily) and smaller spatial scales (e.g., gusts generated by downdrafts from mesoscale convective storms) are not included in the multiple linear regression model. Non-linear interactions and feedback among explanatory variables are also not included. In addition, biases in explanatory variables, e.g., surface winds in North Africa are often underestimated in reanalyses (Largeron et al. 2015) could also affect the results. To fully quantify the contribution of each influencing factor on the formation of the trans-Atlantic dust event would require modelling studies with sensitivity tests, which is beyond the scope of this study and will be examined in the future."

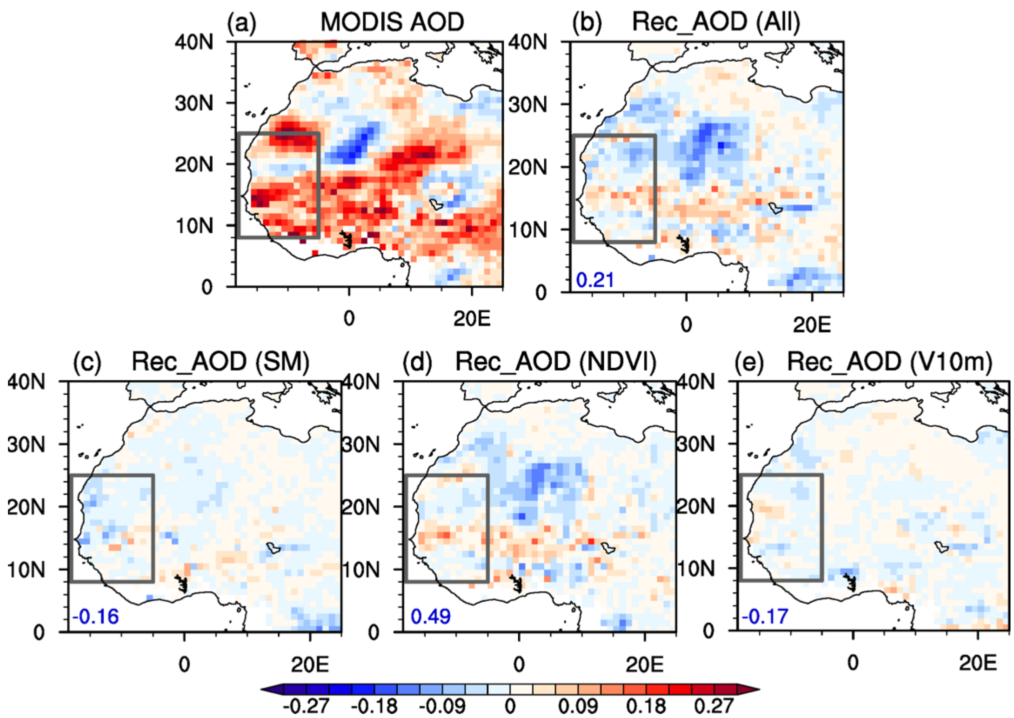

Figure S1. Observed and reconstructed AOD anomalies (with reference to the 2003-2022 climatology) averaged over 3–16 June 2015. (a) MODIS AOD, (b) reconstructed AOD and its components contributed by (c) soil moisture (SM), (d) NDVI, and (e) surface wind speed (V10m). The pattern correlations (uncentered) between the reconstructed and MODIS AOD anomalies over western North Africa (grey box) are shown at the bottom left of each plot.

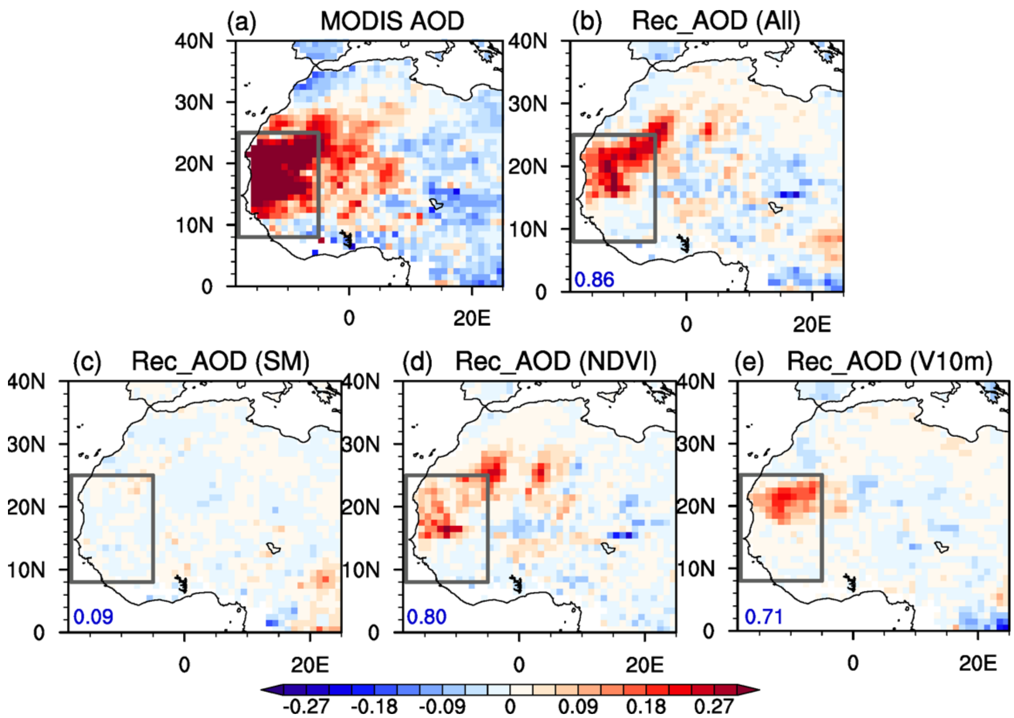

Figure S2. Same as Fig. S1 but for 7–20 June 2020.

Minor comments:

1. It is confusing why a "background" section is needed. In my opinion, this can be shortened and merged with "Introduction".

   We greatly reduced the length of the background section to make the paper more concise. However, we prefer to keep both sections as the introduction section provides an overview of the motivation, research question, and our approaches, while the background section briefly reviews relevant previous studies.

2. Figure 6 some hatched areas correspond to negative wind speed anomaly? How is enhancement of easterly detected?

   For zonal winds, negative (positive) values indicate easterly (westerly) winds. In the figure, we show anomalies of three-day mean zonal winds with reference to the climatological mean in June. So negative (positive) anomalies indicate anomalous easterly (westerly) winds, denoted by blue (red) shading. In the jet core region, the anomalous easterly winds indicate that the African easterly jet was intensified.

3. Figure 7 examines surface circulation, but dust plumes are elevated to ~4km. Surface circulation may not directly impact dust transport.

   African dust plumes slowly sank during their westward propagation across the tropical North Atlantic. When the plumes arrive in the Caribbean basin they often near the surface. This has been documented in previous studies (e.g., Braun 2010; Adams et al. 2012; Groß et al. 2015; Weinzierl et al. 2017; Yu et al. 2021; Pu and Jin 2021) and is also partially shown in Fig. 5. So we focus on circulation patterns at 850 hPa and 925 hPa to understand dust transport in the late stage of the event, i.e., when the plume propagated across the central tropical Atlantic to the Caribbean Basin.

4. Section 4.4.2, Air quality impact: the PM changes may not be solely due to transported dust.

We totally agree. The changes in $PM_{2.5}$ concentrations may include variations in other aerosols in addition to dust. We added lines 589-592 to clarify this. However, Fig. 14 shows that both the timing and location of the increase of $PM_{2.5}$ concentrations are associated with the arrival of the African dust plume (Fig. 3k-o). This suggests that African dust is the dominant contributor to the increase in $PM_{2.5}$. This is consistent with the findings of Chen et al. (2018) who examined the air quality impacts of long-range transported African dust in Texas and Louisiana in June 2015 and found that four sites in Texas reported very high daily maximum $PM_{2.5}$ concentrations from 21 to 23 June 2015 due to the arrival of African dust.

References:

Adams, A. M., Prospero, J. M., and Zhang, C.: CALIPSO-Derived Three-Dimensional Structure of Aerosol over the Atlantic Basin and Adjacent Continents, J. Clim., 25, 6862–6879, https://doi.org/10.1175/JCLI-D-11-00672.1, 2012.

Braun, S. A.: Reevaluating the Role of the Saharan Air Layer in Atlantic Tropical Cyclogenesis and Evolution, Mon. Weather Rev., 138, 2007–2037, https://doi.org/10.1175/2009MWR3135.1, 2010.

Chen, S.-P., Lu, C.-H., McQueen, J., and Lee, P.: Application of satellite observations in conjunction with aerosol reanalysis to characterize long-range transport of African and Asian dust on air quality in the contiguous U.S., Atmos. Environ., 187, 174–195, https://doi.org/10.1016/j.atmosenv.2018.05.038, 2018.

Groß, S., Freudenthaler, V., Schepanski, K., Toledano, C., Schäfler, A., Ansmann, A., and Weinzierl, B.: Optical properties of long-range transported Saharan dust over Barbados as measured by dual-wavelength depolarization Raman lidar measurements, Atmospheric Chem. Phys., 15, 11067–11080, https://doi.org/10.5194/acp-15-11067-2015, 2015.

Pu, B. and Jin, Q.: A Record-Breaking Trans-Atlantic African Dust Plume Associated with Atmospheric Circulation Extremes in June 2020, Bull. Am. Meteorol. Soc., 102, E1340–E1356, https://doi.org/10.1175/BAMS-D-21-0014.1, 2021.

Weinzierl, B., Ansmann, A., Prospero, J. M., Althausen, D., Benker, N., Chouza, F., Dollner, M., Farrell, D., Fomba, W. K., Freudenthaler, V., Gasteiger, J., Groß, S., Haarig, M., Heinold, B., Kandler, K., Kristensen, T. B., Mayol-Bracero, O. L., Müller, T., Reitebuch, O., Sauer, D., Schäfler, A., Schepanski, K., Spanu, A., Tegen, I., Toledano, C., and Walser, A.: The Saharan Aerosol Long-Range Transport and Aerosol–Cloud-Interaction Experiment: Overview and Selected Highlights, Bull.

Am. Meteorol. Soc., 98, 1427–1451, https://doi.org/10.1175/BAMS-D-15-00142.1, 2017.

Yu, H., Tan, Q., Zhou, L., Zhou, Y., Bian, H., Chin, M., Ryder, C. L., Levy, R. C., Pradhan, Y., Shi, Y., Song, Q., Zhang, Z., Colarco, P. R., Kim, D., Remer, L. A., Yuan, T., Mayol-Bracero, O., and Holben, B. N.: Observation and modeling of the historic "Godzilla" African dust intrusion into the Caribbean Basin and the southern US in June 2020, Atmospheric Chem. Phys., 21, 12359–12383, https://doi.org/10.5194/acp-21-12359-2021, 2021.

Reviewer #3

Review of the manuscript titled 'The Emission, Transport, and Impacts of the Extreme Saharan Dust Storm in 2015'

The manuscript titled "The Emission, Transport, and Impacts of the Extreme Saharan Dust Storm in 2015" by Harr et al. discusses the trans-Atlantic African dust event that occurred in 2015, its emission sources, circulation patterns, radiative implications, and impact on air quality. Harr et al. utilized several satellite data products, ground-based measurements, and reanalysis dataset to understand the dust events in this study. It is a well-written work with excellent scientific merit, and I do not hesitate to recommend this manuscript for publication. I have a few minor suggestions below; those can be incorporated during the revision.

We thank the reviewer for the time and effort in reviewing our paper. Your insightful and constructive comments improved our paper. We reply to your comments below. Line numbers refer to lines in the revised manuscript with tracked changes.

Minor comments

1. It appears that the introduction is overly lengthy. Think about making it shorter. Additionally, I would advise including the background information in the introduction rather than in a different section.

   Thanks for the suggestion. We have shortened Sections 1-2. However, we prefer to keep the two sections separate, with the introduction section as an overview of this study and the background section providing a brief review of previous studies of summertime trans-Atlantic dust events.

2. It seems like the introduction cites a lot more sources. I would advise removing any unnecessary citations from here.

   We reduced the number of citations as suggested.

3. I would suggest adding an uncertainty of each of the datasets used in this study as well as its impact to the present study.

   We already discussed the uncertainties for some of the datasets, such as MODIS and VIIRS AOD (lines 179-181), AERONET AOD (lines 245-246), SEVIRI dust RGB (lines 208-210), CERES radiative fluxes (lines 237-241), IMERG precipitation (line 222-225), MERRA-2 DOD (lines 264-267) and ERA-5 soil moisture (lines 279-282). We have added lines 182-183, 190-194, 210-212, and 216-217 to discuss the uncertainties of the rest of the datasets wherever available and their impacts on the present study.

4. Figure 1b: I would suggest showing the 5^{th} and 95^{th} percentile values of AOD.

   We have added both the 5^{th} and 95^{th} percentile values of MODIS AOD (grey dashed lines) to Figure 1b.

5. Figure 3: My recommendation is to enlarge the figure. The readers find it quite challenging to comprehend the parameters. Additionally, make the labels that are utilized larger.

We have enlarged the figure and the labels.

6. Figure 4a: Instead of keeping it as a paired figure like these, I would advise keeping it independent.

   We prefer to have a figure showing the locations of the sites (Fig. 4a) along with the AOD time series with these sites (Fig. 4b-o) so it's easy to find where the sites are. However, we add a line to briefly introduce Fig. 4a (lines 363-365): "Figure 4a shows the number of days during this event with MODIS AOD greater than the 90th percentile of JJA daily values over 2003–2022 and the location of AERONET stations. Over the tropical North Atlantic, large areas experienced extremely high dust loading for two to six days.".

7. Figure-6: Consider modifications to this figure.

   We are not sure what specific modification the reviewer referred to. Do you refer to the way we hatch/dot the figure? This figure demonstrates the change of the African easterly jet (AEJ) during this event, with extremely strong easterly winds and AOD highlighted (dotted and hatched, respectively). We have modified the figure to reduce the density of the dots.

8. Figure-7: Consider plotting the dots at a lower density. Also, the figure shows surface circulation; nevertheless, dust plumes are raised to around 4 km. Dust transport may not be immediately impacted by surface circulation.

   We updated Fig. 7 to reduce the density of the dots. As the African dust plumes propagate westward across the tropical North Atlantic, their thickness, intensity, and plume height slowly decrease (e.g., Braun 2010; Adams et al. 2012; Groß et al. 2015; Weinzierl et al. 2017; Yu et al. 2021; Pu and Jin 2021). Over the western Atlantic and Caribbean, plumes often sink to near the surface. So low-level circulations strongly affect dust transport. For instance, on 18 June 2015, when the dust plume was over the eastern Atlantic, the center of the plume was around 3 km (Fig. 5f), which is around 700 hPa. Due to missing data in CALIOP, we don't know exactly what dust plume height was over the Caribbean, but continuously decaying and sinking is very likely. The patterns of low-level circulation thus are examined in Fig. 7.

9. Figure 8: Consider plotting the dots at a lower density.

   Done.

10. Figure-10a: Consider plotting the dots at a lower density.

    Done.

11. Figure-11: I would suggest to increase the font size of the axis.

    Done.

12. Figure-12: Consider enlarging the figure. Especially the height.

    Done.

13. Figure-14: Consider giving continuous colorbar options than discrete ones.

Thanks for the suggestion. We choose not to change the color bar. For AQI index, the discrete color bar follows the definition of AQI by EPA, e.g., 0–50 indicates good air quality (denoted by green), 51–100 for moderate condition (yellow), 101–150 for unhealthy for sensitive groups (orange), and 151–200 for unhealthy condition (red).
For $PM_{2.5}$ concentrations, the selected color bar interval (5 µg m^{-3}) helps demonstrate the $PM_{2.5}$ guidelines from both the EPA and WMO, which are 35 and 25 µg m^{-3}, respectively.

14. I suggest to remove '~' symbols when the authors are giving absolute values with standard deviation. For example, Line number 516.

To avoid confusion, the symbol was removed.

References:

Adams, A. M., Prospero, J. M., and Zhang, C.: CALIPSO-Derived Three-Dimensional Structure of Aerosol over the Atlantic Basin and Adjacent Continents, J. Clim., 25, 6862–6879, https://doi.org/10.1175/JCLI-D-11-00672.1, 2012.

Braun, S. A.: Reevaluating the Role of the Saharan Air Layer in Atlantic Tropical Cyclogenesis and Evolution, Mon. Weather Rev., 138, 2007–2037, https://doi.org/10.1175/2009MWR3135.1, 2010.

Groß, S., Freudenthaler, V., Schepanski, K., Toledano, C., Schäfler, A., Ansmann, A., and Weinzierl, B.: Optical properties of long-range transported Saharan dust over Barbados as measured by dual-wavelength depolarization Raman lidar measurements, Atmospheric Chem. Phys., 15, 11067–11080, https://doi.org/10.5194/acp-15-11067-2015, 2015.

Pu, B. and Jin, Q.: A Record-Breaking Trans-Atlantic African Dust Plume Associated with Atmospheric Circulation Extremes in June 2020, Bull. Am. Meteorol. Soc., 102, E1340–E1356, https://doi.org/10.1175/BAMS-D-21-0014.1, 2021.

Weinzierl, B., Ansmann, A., Prospero, J. M., Althausen, D., Benker, N., Chouza, F., Dollner, M., Farrell, D., Fomba, W. K., Freudenthaler, V., Gasteiger, J., Groß, S., Haarig, M., Heinold, B., Kandler, K., Kristensen, T. B., Mayol-Bracero, O. L., Müller, T., Reitebuch, O., Sauer, D., Schäfler, A., Schepanski, K., Spanu, A., Tegen, I., Toledano, C., and Walser, A.: The Saharan Aerosol Long-Range Transport and Aerosol–Cloud-Interaction Experiment: Overview and Selected Highlights, Bull. Am. Meteorol. Soc., 98, 1427–1451, https://doi.org/10.1175/BAMS-D-15-00142.1, 2017.

Yu, H., Tan, Q., Zhou, L., Zhou, Y., Bian, H., Chin, M., Ryder, C. L., Levy, R. C., Pradhan, Y., Shi, Y., Song, Q., Zhang, Z., Colarco, P. R., Kim, D., Remer, L. A., Yuan, T., Mayol-Bracero, O., and Holben, B. N.: Observation and modeling of the historic "Godzilla" African dust intrusion into the Caribbean Basin and the southern US in June 2020, Atmospheric Chem. Phys., 21, 12359–12383, https://doi.org/10.5194/acp-21-12359-2021, 2021.

Reviewer #4

General comments:

- Solid objective: To study a dust event similar to the Godzilla dust plume, but with less intensity.
- Nicely shown how the enhanced AEJ, CLLJ, and extension of NASH encourage the long-range transport of dust in this region, consistent with previous studies.

  We thank the reviewer for the time and effort in reviewing our paper. Your insightful and constructive comments improved our paper. We reply to your comments below. Line numbers refer to lines in the revised manuscript with tracked changes.

- I would like to see a short summary (If you can add a table to section 4.5, that would be great!) on the similarities and differences between the two events (in the context of emission, transport, radiative, and air quality impacts). Moreover, the way you guys used different figures to tell your narration says that you are creative. So be creative with the table too 😊

  Thanks for the great suggestion. We added Tables 1– 2 and some discussion (lines 615-619, 627-629) to Section 4.5 to better compare the two events. While Table 1 summarizes the characteristics of the events (e.g., magnitude and duration of AEEs over dust source region and the tropical North Atlantic) and the radiative and air quality impacts of the events, Table 2 shows the correspondent atmospheric circulation and land surface conditions that affect the emissions and transport of African dust plumes in both events. Following the suggestion of Reviewer #2, we also added a discussion about the relative importance of each land surface variable in dust emissions in the two events at the end of Section 4.3.

- The study extends to radiative impacts and air quality as well, providing a full package, although the radiative effects and air quality impact parts are not as comprehensive as the emission and transport parts.

  Thanks for the comments. We mainly focused on the emissions and transport of the extreme dust plume but also included the radiative and air quality impacts of the events via both satellite products and station data. A full examination of the impacts of extreme African dust plumes will need modeling studies that rule out the impacts of other aerosols (such as sea salt and anthropogenic aerosols) and clouds, which is outside the scope of this study and will be explored in the future.

- The text mentions different places (e.g., Taoudenni, Guadeloupe, and more). A small figure showing these places would be handy, especially for folks like me who struggle with geography 😊

  Thanks a lot for the suggestion. We added the country names (e.g., Mauritania, Mali, Niger, Algeria, Burkina Faso) used in the paper to Fig. S1 to improve clarity.

- Just curious, would there be a possibility that you missed some AEEs (or underestimated the strength of AEE) because of the lack of AOD observations due to the clouds?

Yes, that's possible. How missing values in MODIS AOD may affect the calculation of AEEs is partially discussed in lines 309-311. We added lines 307-308 to better clarify uncertainties of cloud screening and missing data in AEE calculation: "Note MODIS AOD in the study region contains missing values largely due to cloud screening, which may affect the calculation of AEEs. Here only days where the averaging area has less than 30% missing AOD values are used in AEE calculations, and this criterion mainly affects the AEEs over land (Fig. 1b). Slightly increasing or reducing the missing value threshold (e.g., to 20% or 40%) does not change the AEE days over the ocean".

Line by line comments:

Line 54: Nicely summarized Introduction!! Perhaps adding specific names for satellites, ground stations, and reanalysis products within brackets would be super useful in this sentence.

Done.

Line 60: What does "SAL" really stand for?

"SAL" stands for "Saharan air layer", which is introduced in line 32.

Line 281: Here, you compare the 2020 event with the one studied here (the 2015 one). Are the regions and AOD thresholds used to define the 2020 event the same as those used here, as shown in Fig. 2? If so, you should indicate that.

Yes. The averaging regions used to calculate AEEs and the threshold (i.e., above the 90^{th} percentile) are the same. We revised lines 302-303 to clarify this.

Line 525: This is why I suggest including a table to compare and contrast the Godzilla event and this one. One can see in terms of air quality, what the differences or similarities are (see my general comments).

We followed the advice and added Tables 1 and 2 and some discussion to Section 4.5 to compare the two events.