Manuscript Summary

This study explores the relationships between dust in the Saharan air layer and the development of African easterly waves across the tropical Atlantic Ocean using 22 years of daily satellite AOD observations, as well as reanalysis MERRA-2 data based on satellite assimilation.

General Comments

Introduction:

Most references were dated. There is a lack of essential updated references in the manuscript. I found plenty of articles related to the topics described in this manuscript that were not reviewed. Here are a few examples:

1. Francis et al. (2021).The dust load and radiative impact associated with the June 2020 historical Saharan dust storm. https://doi.org/10.1016/j.atmosenv.2021.118808
2. Meloni et al., (2018). Determining the infrared radiative effects of Saharan dust: a radiative transfer modeling study based on vertically resolved measurements at Lampedusa. https://acp.copernicus.org/articles/18/4377/2018/
3. Bercos-Hickey et al., (2017). Saharan dust and the African easterly jet–African easterly wave system: Structure, location, and energetics. https://doi.org/10.1002/qj.3128
4. Konare et al., (2005). A regional climate modeling study of the effect of desert dust on the West African monsoon. https://doi.org/10.1029/2007JD009322.
5. Grogan et al., (2017). Effects of Saharan Dust on the Linear Dynamics of African Easterly Waves. https://doi.org/10.1175/JAS-D-15-0143.1.
6. Grogan et al., (2019). Structural Changes in the African Easterly Jet and Its Role in Mediating the Effects of Saharan Dust on the Linear Dynamics of African Easterly Waves. https://doi.org/10.1175/JAS-D-19-0104.1
7. Bercos-Hickey et al., (2019). Structural Changes in the African Easterly Jet and Its Role in Mediating the Effects of Saharan Dust on the Linear Dynamics of African Easterly Waves. https://doi.org/10.1175/JAS-D-19-0104.1
8. Francis et al. (2020). The Atmospheric Drivers of the Major Saharan Dust Storm in June 2020. https://doi.org/10.1029/2020GL090102

General Body:

1. The manuscript, in its current state, has room for improvement. For example, flow, the order of the figures' numbering, and lack of tables to help the audience to understand the results the authors intend to disseminate.
2. There is no discussion about their results (especially section 3 and conclusions) with updated research (For example, the above references). The manuscript needs to be improved and justified through discussions of novel peer-reviewed publications.
3. The intention of using satellite data is essential. But, the co-authors need to investigate each algorithm's appropriate use more. For example, I can't entirely agree with using

MERRA-2 AOD or MODIS Level 3 AOD retrievals. MERRA-2 Reanalysis and MODIS Level 3 retrievals underestimate/overestimate aerosol loading for dust and smoke. On the other hand, level 2 satellite aerosol retrievals characterize better aerosol loading. There is information in the manuscript that is not entirely correct. I encourage co-authors to investigate more about these aerosol products.

4. This manuscript needs better organization. It reads disorganized and rushes in the necessary information.

Specific Comments

Introduction:

1. There was no mention of the significant African aerosol components or the African dust and fire seasons.
2. It should be mentioned when the Biomass and Dust season overlap.

Data and Methodology:

1. While the temporal domain is stated, the spatial domain is hard to find. Also, I am unsure if the averaging method is per grid size or for the entire square domain. How many grids are contained in those squares? It would be helpful to state all those details to understand the methodology further.
2. It would be helpful to create a Methodology section for data manipulation of AOD. While AOD was vaguely mentioned, unfortunately, there is no explanation of how the co-authors intended to use it. In addition, there is no information about wavelength or the retrieval collection used.
3. Page 6; Lines 1-4: No relevant. Provide information just about MERRA-2.
4. Page 6; Line 21: dated reference: Please update for:
    a. Remmer et al. (2021). The Dark Target Algorithm for Observing the Global Aerosol System: Past, Present, and Future. https://doi.org/10.3390/rs12182900
5. While MERRA-2 Reanalysis is cited, it's unclear at this point what variables were used. MERRA-2 contains multiple aerosol weather variables assimilated. It would be helpful to create a table with the variables employed in the analysis.
6. Page 6; Line 22: he Deep-blue algorithm is mentioned but never cited. A few useful references:
    a. Sayer et al. (2019). Validation, Stability, and Consistency of MODIS Collection 6.1 and VIIRS Version 1 Deep Blue Aerosol Data Over Land. https://doi.org/10.1029/2018JD029598.
    b. Hsu et al. (2019). VIIRS Deep Blue Aerosol Products Over Land: Extending the EOS Long-Term Aerosol Data Records.
7. Page 7: Lines 1-4. The selection of the studied period states:"*… This study focuses on boreal summer months, JJA, from 2000 to 2021 because during this season, the amplitude of AEWs peaks (e.g., Roundy and Frank, 2004), and Saharan dust storms are active without simultaneous transport of smoke aerosols from biomass burning as*

observed during the fire seasons…." I suggest all co-authors study the NASA ORACLES campaign.

   a. Redemann et al., (2020). An overview of the ORACLES (ObseRvations of Aerosols above Clouds and their intEractionS) project aerosol–cloud–radiation interactions in the southeast Atlantic basin. https://acp.copernicus.org/articles/21/1507/2021/
   b. Cochrane et al., (2019). Above-cloud aerosol radiative effects based on ORACLES 2016 and ORACLES 2017 aircraft experiments. https://amt.copernicus.org/articles/12/6505/2019/
   c. Cochrane et al., (2021). Biomass burning aerosol heating rates from the ORACLES (ObseRvations of Aerosols above Clouds and their intEractionS) 2016 and 2017 experiments. https://amt.copernicus.org/articles/15/61/2022/

8. I am skeptical that in 20 years of the study, the atmosphere would not have a mix of smoke and dust on specific episodes. But unfortunately, there is no methodology from the co-authors to warranty the presence of dust.
9. Page 8: Line 6. It would be helpful to the reader to start refereeing the figures in order. For example, referencing Figure 2 confused me and made me go back several times to ensure I did not miss Figure 1.
10. Section 2.3: The weather variables used in this study were finally introduced here. However, this format is very disorganized because this section supposes to be about the calculation of MKE instead of introducing MERRA-2 variables or algorithms.
11. Page 8: Lines 9-11. The introduction of GOCART should not have been explained in this section, which is about the formulation of MKE.
    a. Randles et al. (2017). The MERRA-2 Aerosol Reanalysis, 1980 Onward. Part I: System Description and Data Assimilation Evaluation. https://journals.ametsoc.org/view/journals/clim/30/17/jcli-d-16-0609.1.xml
    b. Goddard Chemistry, Aerosol, Radiation, and Transport model (GOCART)
12. For sections 2.3, 2.4, and 2.5, are the averages per grid cell or for the entire domain?

Summary of the results

1. Page 17. Lines 1-9. Deep-blue has an ocean retrieval for Levels 2 and 3 data and for VIIRS. Please, edit accordingly. This would not be a challenge using level 2 data for this manuscript. Check page 127 https://atmosphere-imager.gsfc.nasa.gov/sites/default/files/ModAtmo/L3_ATBD_C6_C61_2019_02_20.pdf
2.
3. Page 17. Line 17: How did you calculate aerosol shortwave radiative forcing from the MERRA-2? It would be nice to reference Eq. 1
4. Have you compared MERRA-2 AOD with the satellite data? While correlation factors are high and p values are low, the magnitude in the color bars and gradients of the data in the maps are different. I want to remind co-authors that two datasets can have high

correlation factors with high biases. My concerns are related to the ocean gradient specifically.

5. Page 19. Lines 1-3. I encourage you to show these results in an appendix.
6. Section 3.3 states previous studies have discussed the development of the AEWs, but I did not find any reference or comparison to other studies in sections 3.3.1 and 3.3.2.

Conclusions

Conclusions in this manuscript are not reinforced by any peer-review publication.

Data availability

Page 26. Line 9: Use MODIS AOD retrievals instead of observations. This study did not use direct observations from MODIS.

Figures

Figure 2.a. Did you mean MODIS Dark-Target AOD (550 nm) ? Did you use 500 nm instead of 550 nm?
https://atmosphere-imager.gsfc.nasa.gov/sites/default/files/ModAtmo/L3_ATBD_C6_C61_2019_02_20.pdf
Figure 2.b. Did you mean MODIS Deep-Blue AOD (550 nm). I encourage consistency in figs 2 a and b.