

Atmos. Chem. Phys. Discuss., author comment AC2
<https://doi.org/10.5194/acp-2021-73-AC2>, 2021
© Author(s) 2021. This work is distributed under
the Creative Commons Attribution 4.0 License.

Reply on RC2

Hongbin Yu et al.

Author comment on "Observation and modeling of the historic "Godzilla" African dust intrusion into the Caribbean Basin and the southern US in June 2020" by Hongbin Yu et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-73-AC2>, 2021

We thank the reviewer for the comments and have revised the paper accordingly. Below is our point-to-point response to the comments and suggestion.

This study uses multiple satellite retrievals, ground-based observations, and GEOS global aerosol transport model to characterize a historic African dust event in June 2020. Compared with climatological geopotential height in June, the anomalous strength and northern shift of NASH together with Azores low contributes to the four-day accumulation of the dust near the African coast. Although the GEOS model can reproduce the historic dust event to some extent, it substantially underestimates AOD and aerosol extinction profiles compared with MODIS and CALIOP. The manuscript is well written, and results are clearly presented and well discussed. This study is a valuable contribution to understanding the synoptic factors favoring extreme dust events and improving model performance in simulating dust emission and transport. I only have minor comments and recommend publication after they have been answered.

Thanks for the comments.

General Comments:

What could cause the anomalous synoptic condition favoring extreme dust events like this one? Is it just due to natural variability, looking at the time series of the geopotential height in Fig. 12d? Or we might expect stronger and/or more frequent dust events in the future due to global warming? I also wonder if the reduction of anthropogenic emissions (i.e., greenhouse gases and aerosols) during COVID could play a role here. It is probably out of the scope for this study, but I would love to hear the authors' opinions on this. Such discussions could benefit future studies.

These are all great and important questions. The time series of the geopotential height in Figure 12d show substantial year to year variations but no significant trend. To attribute the observed changes to natural or anthropogenic factors, one would need to run a reliable earth system model to assess how changes in anthropogenic emissions have affected atmospheric circulations and dust transport, which is beyond the scope of this paper.

The reviewer raised an intriguing question about possible impact of anthropogenic emission reduction due to the lockdown during COVID-19 pandemic. Considering that

Godzilla-like dust events have not occurred so far in 2021, we would like to believe the 2020 Godzilla dust event was not likely a direct result of the anthropogenic emission reductions due to the COVID-19 lockdown. The two events might be just coincident.

It is very rare for African dust to make it into the tropical eastern Pacific. I wonder which factors could play a major role here, the anomalous NASH or stronger AEJ? In Fig. 12, the high-pressure system over the western Africa in June, 2020 greatly extends to the Gulf of Mexico compared with 1980-2019 climatology.

Great question. Yes, previous observations have suggested that African dust is rarely transported to the tropical eastern Atlantic Ocean, because of the existence of apparent barrier in central America (e.g., Nowottnick et al., 2011). Pu and Jin (2021) showed that AOD over eastern Pacific Ocean was negatively correlated with AEJ index, suggesting that the stronger AEJ would not be a reason for the elevated AOD over the Pacific Ocean. Both Pu and Jin (2021) and our analysis show that the high-pressure system in the tropical Atlantic Ocean in 2020 extended greatly to the Gulf of Mexico, in comparison to the climatology. This anomalous westward extension of the high-pressure system would be responsible for the record-breaking transport of African dust into the tropical eastern Pacific Ocean (shown in Figure 9g).

Specific comments:

Line 87, evolved to evolve?

Fixed. Thanks.

Figure 3 and 16, it might be better not to use black color for the background?

We replot the figures by using white background.

Figure 4, please add labels for the panels (e.g., a-h). It would be better to add a brief description for what is shown in color map (Fig. 4a).

Labels added. Thanks.

Figure 5, it would be better to change the latitude/longitude marks for CALIOP aerosol extinction curtains to be consistent with Fig. 13, 14, and 17.

We have changed the latitude/longitude marks in Figure 5 and Figure 7 to be consistent with other CALIOP curtain plots. Thanks.

Figure 17, please add labels for the panels.

Thanks. The panels have been labeled.