**We thank the reviewers for their supportive and thoughtful comments. Our responses to the comments are provided below in a red font, with the reviewers' comments in a black italicized font.**

## Review #1

***General Comments:***

*This is a very well written paper that discusses several aspects of the Saharan dust transport towards the Amazon Basin, from its origin to the impacts over the South American rainforest. The use of the chemical transport model GEOS-Chem, constrained by observations, is a very interesting approach, since it allows the assessment of regions and features not possible by real world observations, while validation against real world observations assure the general accuracy of the simulations. This paper represents a valid effort to better understand the transport and impacts of the Saharan dust.*

Thanks for the reviewer's thoughtful comments to help us improve the manuscript. We have now addressed all the concerns. Please see our detailed reply below.

1. *Some aspects about methodology and results of the comparison between AERONET observations and PMSD schemes might need some clarification. Between lines 185-187, you say that only observations dominated by coarse aerosols are used [(contribution of fine aerosol to total aerosol volume < 3%)]. But figure 3 also shows box-plots of the mass fractions of column integrated aerosols in the 0.1-1.0 micrometers size bin. In addition to that, according to figure 1, you also use one AERONET site on an island and at least two sites (in Marrocco and in Tunisia) not far from the coast. I wonder if sea salt contribution to coarse size aerosols will significantly affect the observations. And if yes, to what extent. If what the observations show are significantly affected by sea salt, extra care should be taken while drawing conclusions from the comparisons.*

*Some clarification on this aspect of the methodology and how this could affect the results could be helpful.*

Sorry for the confusion. The data screening criteria are slightly different between Fig. 3 and Fig. 4. It is more stringent for Fig. 3 as it is for the evaluation of PMSD of dust in GEOS-Chem. So it only uses data dominated by dust, namely when the contribution of dust to column-integrated aerosols mass concentrations in the model is higher than 95%. Therefore, it contains the mass fractions of column integrated aerosols in the 0.1-1.0 micrometers size bin. The influence of sea salt is limited with this screening criterion. For Fig. 4, it uses the data dominated by coarse aerosols (the contribution of fine aerosol to total aerosol volume < 3%) based on the AERONET PVSD to have more data available for the comparison between observed and simulated AOD. We have revised the text between lines 222-231 to make it more clearly: "**In addition, to minimize the influence of aerosols other than dust, only data dominated by dust (simulated dust contribution to column-integrated aerosols mass concentrations > 95%) is used for the comparison of PMSD. There are a few sites not far from the coast and could be influenced by sea salt. With the above data screening, the sea salt contribution to total aerosol mass is less than 0.5%. For the comparison of AOD, the criterion is less stringent to have more data points available and uses data dominated by coarse aerosols (the contribution of fine aerosol to total aerosol volume < 3%). This criterion does not exclude sea salt and the contribution of sea salt to AOD could be up to 30% at the Capo_Verde site (22.9° W,16.7° N) over the east of the Atlantic Ocean.**"

2. *The discussion about the dust emissions (section 3.1) feels incomplete. The winds being a major driver of the emissions is an important and interesting aspect, but it was already pointed out in several previous papers. The potential relevance of soil moisture for all regions except for region D, suggested by the significant negative correlations, is another important and interesting aspect but also a more*

*novel one, which should be more highlighted and/or discussed (e.g. in the conclusions). Regarding the winds, I expected a wider discussion on the local and synoptical meteorological aspects which result in those winds. This is briefly discussed around line 268, where the emissions from central Sahel and west Sahel are mentioned. But Region A (west Sahara), referred to as the biggest dust source, is not even mentioned.*

Thank you for the nice suggest. We now add more discussion regarding the influence of winds and soil moisture in lines 405-411: "**Fiedler et al. (2013) also found a maximum of emission flux over the Bodélé Depression in winter and the highest emission flux in spring in west Sahara. The study suggested that near-surface peak winds associated with Nocturnal Low-Level Jets is a driver of mineral dust emissions. Negative correlation between dust emissions and soil moisture has also been revealed by Yu et al. (2017) and Pierre et al. (2012), as the decreased vegetation growth in response to dry soil would result in enhanced dust emissions.**"
We also modified the conclusion to highlight the results in line 622-624: "**The correlation analysis suggests high surface wind speeds and low soil moisture as a major driver for dust emissions.**"

3. *The dust lifetime is presented in section 4, and the differences are justified mostly by dry deposition near the source and by wet deposition along the transport path. That is another interesting result, but I also feel it could have a wider discussion, especially regarding the aspects involving dry deposition. Different seasons will obviously have different meteorological and thermodynamic conditions and these different conditions will result in different structures of the dust plumes. I would expect this to be of big relevance for the dust lifetime. I would recommend the reading of "The Three-Dimensional Structure of Transatlantic African Dust*

*Transport: A New Perspective from CALIPSO LIDAR Measurements" by Liu et al. (2012), and/or related papers.*

Thank you for the insightful comment. We now had more discussion regarding dust lifetime in line 456-462: **"The seasonality in the deposition fluxes and the consequent dust lifetime depends not only on precipitation but also the vertical pathways of dust transport across the Atlantic. Dust aerosols aloft at higher altitude reach further west and have relatively longer lifetime. Significant differences in dust vertical distributions along the transport pathways have been revealed from the CALIOP measurements, which show that more dust is transported above 2km in summer while the dust layer is the shallowest in winter (Liu et al., 2012)."**

***Specific Comments:***

*1. l. 36: Pg $a^{-1}$ is an unusual notation, I would recommend using (in this line but also in the rest of the manuscript) a more common notation like Pg $yr^{-1}$*

We have modified the unit throughout the manuscript.

*2. l. 54: You wrote downwards, but I think you meant downwind?*

We have corrected the mistake.

3. *l. 96: It would be nice if you included more information about where El Djouf is located. Either "El Djouf, between Mauritania and Mali" or "El Djouf, in western Sahara".*

Thanks for the comment. We have modified the text to specify it: **"**Yu et al. (2020) argued that El Djouf**, in western Sahara,** contributes more dust...**"**

4. *l. 203: I think there should be a comma after "Amazon Basin".*

We have added the comma.

5. *l. 300: Please include units.*

   Done.

6. *l. 509: I think you meant "exists" and not "exits".*

   We have corrected the typo.

7. *l. 534: Units for the first values are missing.*

   Thanks for the comment. We have added its unit.

8. *l. 595: Maybe substitute "consistent" with "significant".*

   Thanks for the comments. The sentence is deleted in the revised manuscript.