Atmospheric Chemistry and Physics Discussions

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Comment on acp-2020-1138

Anonymous Referee #1

Referee comment on "On the role of aerosol radiative effect in the wet season onset timing over the Congo rainforest during boreal autumn" by Sudip Chakraborty et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-1138-RC2, 2021

Using multi-satellite and re-analysis data, this study presents the role of aerosols in the early onset of wet season over the Congo rainforest. The increase in aerosol optical depth during the dry season results in surface cooling and enhanced meridional temperature gradient, which influences the AEJ-S and thus precipitation. Because of the inherent limitations of observational datasets, the Authors could not demonstrate aerosol-induced surface cooling as the major pathway for the early onset of the wet season. Results are not convincing and mostly speculative in nature. Moreover, authors should use long-term data (not just 3 years each for late and early onset conditions) to establish the link between aerosols and AEJ-S. It is not clear whether high aerosol loading during the dry season is a forcing mechanism or a prior indicator (proxy) for the early onset of the wet season and strengthening of AEJ-S. In the case of the former, authors should strengthen the study using more supporting evidence (probably some modelling attempts). Substantial revision is required before accepting this manuscript for publication in ACP. Major issues are:

- Authors mentioned that "the mean AOD in the dry season over the region is strongly correlated (r =0.7) with the timing of the subsequent wet season onset". Is it statistically significant? Please label the points corresponding to early and late onset years in Figure 6.
- How good is MODIS data over the study region? Provide information on validation studies using ground-based radiometers.
- What about the effects of diabatic heating of the atmosphere due to aerosol absorption on AEJ-S and thus on precipitation? How does aerosol cooling lead to an increase in cloud cover, cyclonic motion, and precipitation?
- Change in meridional temperature gradient (which strengthens AEJ-S) due to aerosol forcing needs to be investigated further. Show the figure for early and late onset years.
- Please include discussion on year to year variability of AOD, cloud and AEJ-S for early and late onset years. Whether the standard deviation of the regional mean AOD for the early onset years (2007, 2011, 2012) is comparable to the change in AOD for early and late onset years?
- High clouds cover did not show a significant difference between late and early onset

years. Whereas low/middle clouds show a difference in early and late onset years. This contradicts the author's claim.

- Whether aerosol-cloud interaction is significant enough to consider as a forcing mechanism responsible for the extended drying over the Congo rainforest.
- Line 220-221: How do authors classify cloud cover as "low, mid-low, mid-high, and high". I presume it is based on fractional cloudiness (not for cloud altitudes). If So, how do authors have a 25% cloud cover fraction as high/midhigh in Figure 2B.
- Low and midlow clouds are high for late onset years. This could lead to a significant surface cooling, sometimes higher magnitude than the aerosol-induced cooling in early onset years.
- Authors mentioned that "aerosol induced cooling in early boreal summer (June-mid July) leads to higher cloud cover and precipitation in the late summer". There is no supporting or strong evidence to show that aerosols are the primary factor, which drives the high cloud cover and precipitation. Moreover, Figure 3 doesn't show a significant difference between the high cloud cover for early and late onset years. Do authors think that AOD change of ±0.1 (Figure 4a) is sufficient enough to change the large-scale circulation and precipitation over the region? It may be misleading to attribute the surface temperature decrease and strengthening of AEJ solely to aerosol-radiation interaction. For example, change in aerosol optical depth and clear sky SW radiation showed a reasonable association, as expected (Figure 4). But the temperature change is not following the change in AOD and SW. This shows the complexity of the problem which demands modelling studies to delineate or quantify the contribution of aerosol forcing to the observed onset of the wet season.
- Explain what is integrated aerosol mass flux? Is it for zonal or meridional? What is the advantage of using aerosol mass flux instead of AOD to show that change in AOD is due to dust?
- Provide reference wind vector in Figure 8. What is the difference between Figure 7D and Figure 8?
- What is SAE-J in Figure 9? Is it AEJ-S?
- Line 179: Remove the period after "with a"
- Line 199: Replace "data setsc" with "data sets"
- Line 154: Replace "GPGP" with "GPCP"