We are thankful to the reviewers for their insightful comments and help improving the manuscript.

Reviewer #1 (Comments to Author (shown to authors):

Thank you very much for your suggestions and the insightful comments. We have made changes to the manuscript following your suggestions. The changes are highlighted in yellow.

1. Line 59: The season abbreviation for September to December is given as SON. In analogy with other season MAM, it should be SOND?

Corrected. Thank you for pointing this out. Line 59

2. Line 143-150: The section gives an idea what authors did in the present manuscript. However, the connectivity from the previous paragraphs is not there. The section should be improved to clearly state the objective of the present work blended with the previously known knowledge.

We have added two sentences to make connections between the two paragraphs (line 143-145)

3. Section 2, Line 154: is it GPGP or GPCP?

Corrected. Thank you for pointing this out. Line 156

4. Line 173: Can authors explain the rationale behind choosing the MODIS Aqua data and particularly deep blue algorithm?

Deep blue algorithm was developed to detect aerosols over bright surface, which is not the case for this study. So, we have removed deep blue algorithm. Thanks for pointing this out.

We have added discussions on the use of the MODIS AOD data that have been used previously in many studies over the region in line 178-183.

5. In general, it was observed that the magnitude from re-analysis data is different to the satellite observations. Can authors comment on this aspect for their work, and how MERRA-2 was still able to pick up the dynamics expected by the authors?

MERRA2 aerosols flux data have been used to have an understanding about the dominant species of aerosols present and transport over the region in the study. The MERRA2 data have been used previously to understand global aerosols transport. MERRA2 aerosol reanalysis data have been validated against many AERONET stations data globally. We have mentioned that in lines 208-217. In our study, to compare with the satellite data, we have shown the MODIS AOD map (Figs. 7A-C) over the region along with the MERRA2 aerosols mass flux (Figs. 7D-H). The Figures show a reasonable agreement between MODIS June AOD (Fig. 7A) and MERRA dust mass flux (Fig. 7D). We have added this in lines 377-381. However, we agree with the reviewer that a detailed further study is need to understand the role of the regional dynamics on the aerosol transport over the region. We have added that in the conclusion section in lines 449-455: "Our analysis using MERRA2 reanalysis data indicates that the location and strength of the AEJ-N and the tropical easterly jet might play an important role in the AOD variation (Fig. 7). However, further analysis is required to tease out the role of these jets and their interannual variability on the dust mass flux and wet season onset. MERRA2 reanalysis data suggest the possibility of long-range aerosol transport by AEJ-N. A detailed analysis using satellite as well as ground-based measurements and model simulations can shed more light on the role of dynamics over the region on the aerosol concentration."

6. Figure 6: I am unable to believe the correlation and fit provided by the authors. Please check the June AOD fit and corresponding r value given. Which points the line is fitting to? It seems that the scattering is too high and somewhere in between the software fit the line to give some result. Same goes with JJA AOD fit.

We have added the r values and the p values plotted using the scipy module of python.

7. Can authors give few bullet points in their conclusion?

We have added the bullet points in the discussion section on how aerosols led to an early onset.

Reviewer #2 (Comments to Author (shown to authors):

Thank you very much for your suggestions and the insightful comments. We have made changes to the manuscript following your suggestions. The changes are highlighted in yellow.

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:

1. 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.

We have added the r values and the p values. The early and late onset years have also been marked.

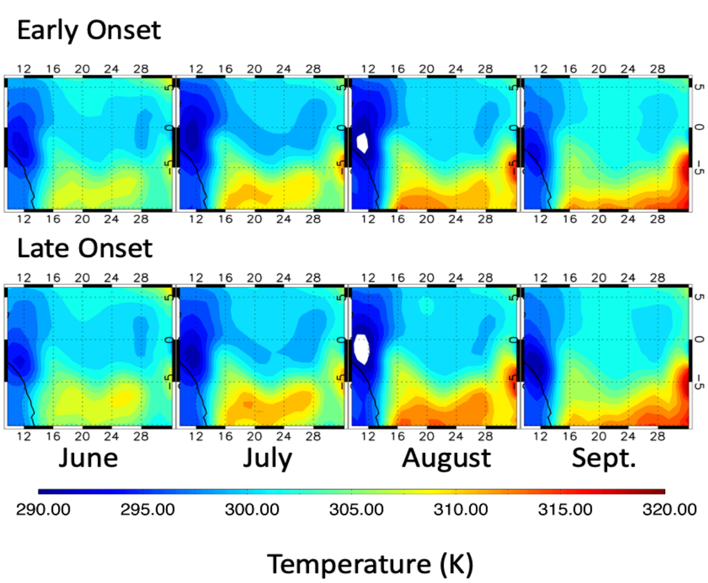
2. How good is MODIS data over the study region? Provide information on validation studies using ground-based radiometers.

We have added discussions on the use of the MODIS AOD data in lines 178-183. The MODIS AOD data have been used previously in many studies over the region and validation against AERONET stations data.

3. 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?

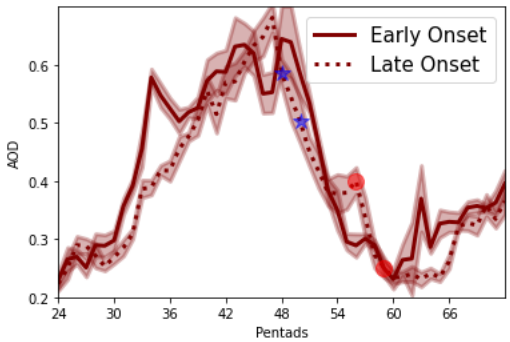
Based on the observations, it appears that an early increase in AOD leads to a surface cooling over the Congo rainforest. Thus, meridional temperature gradient with respect to the Kalahari Desert increases. That leads to an early onset of AEJ-S. As a result, the region experiences a relatively stronger convergence and the circulation is also relatively cyclonic in the early onset years as compared to the late onset years in June-July. As a result, high cloud cover (Fig. 2B) and precipitation (Fig. 2A), which were insignificantly different in June-July, become significantly higher in the early onset years (upto 11%) in August and the wet season begins. We have added this in the discussion section (lines 397-403). To fully substantiate the effects of aerosols' diabatic heating, we have conducted WRF-Chem simulations. The results will be reported in a separate manuscript.

4. 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 see the temperature plots shown here. The differences in Ts between the early and late onset years is ~3K, which is also observed when we plot the actual temperature. A slightly higher temperature is observed in the bottom row (late onset years). It should be noted that in June-July, the Sun is in the northern Hemisphere. Thus, a slight difference in the temperature due to the aerosols in the southern hemisphere can lead to the formation of the AEJ-S. We have added this as a supplementary Figure S1 (lines 295-299).

5. 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?



Please see the AOD plot shown here. It shows that the differences in AOD between the early and late onset years is significant during 30-40 pentads or June-late July. Such an early difference in AOD causes the Ts differences during June-July (Figure 3) and the domain mean temperature (Fig. 4B). That leads to an early onset of the jets compared to the late onset years. Please see Figure S2 (also below) for the wind speed differences. The wind is westerly during the late onset years in June, but is easterly during early inset years below 10°S where the SEA-J is generally known to form (Adebiyi and Zuidema, 2016). In July, AEJ-N recedes. The stronger easterly wind spreads over the rainforest. Due to a stronger AEJ-S, the convergence increases (Figs. 5) and the circulation becomes cyclonic in the northern part of the rainforest over the domain in August. Stronger easterly wind is also noted in August-September. Please see lines 284-286 and 289.

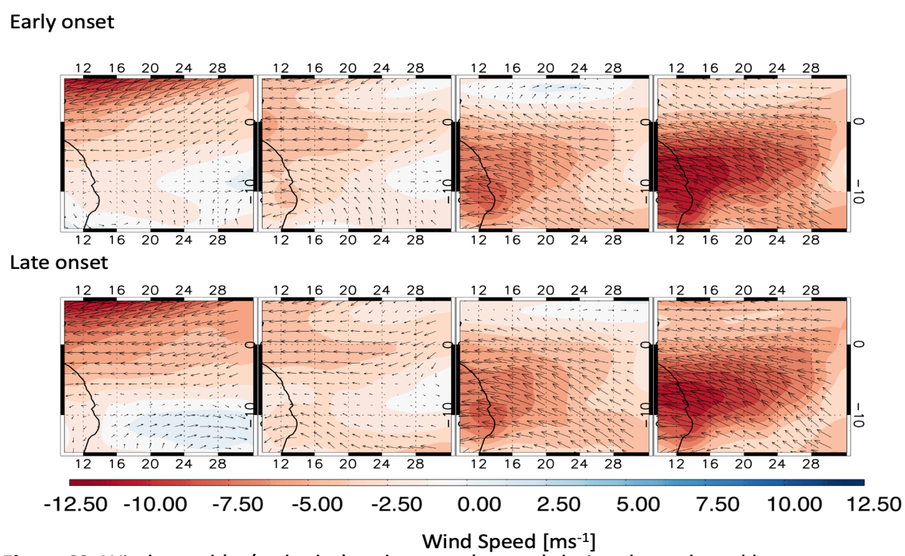
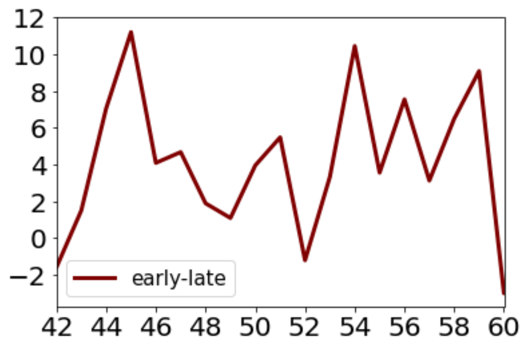


Figure S2. Wind speed (m/s; shades) and vectors (arrows) during the early and late onset years.

However, we feel that it is important to investigate the influences of the dynamics of AEJ-N on the wet season onset and also, on the aerosol loading. Aerosol radiative effect may not be the only reason for the early onset. We have noted the in the conclusion section (lines 449-455).

6. 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.



High cloud cover is significantly different up to 11% in August (45th pentads). We have mentioned that in lines 271 and 402. See the plot below showing the difference between 42-60 pentads or August-October.

7. Whether aerosol-cloud interaction is significant enough to consider as a forcing mechanism responsible for the extended drying over the Congo rainforest.

It might be possible that aerosol microphysical effect plays an important role in the cloud formation. We haven't addressed that in this study. This will be considered in a future study. We have mentioned that in the conclusion (lines-457-458).

8. 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.

Here low/ high indicates the cloud's altitude, not the coverage. Please see Minnis et al, 2011 and Doelling et al, 2013 for cloud altitude classification in the CERES data. In the CERES SYN1deg data, the cloud top altitude is defined as : low (<700 hPa); midlow (700-500 hPa), midhigh (500-300 hPa), and high *(>300 hPa).

Minnis P, et al. (2011) CERES Edition-2 cloud property retrievals using TRMM VIRS and Terra and Aqua MODIS data—Part I: Algorithms. IEEE Trans Geosci Remote Sens **49**(11):4374–4400.

Doelling DR, et al. (2013) Geostationary enhanced temporal interpolation for CERES flux products. J Atmos Ocean Tech **30**(6):1072–1090.

9. 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.

Although low clouds can also induce surface cooling, our results show the low cloud cover is higher during the late onset years when the rainforest surface is warmer than the early onset years. The reason why we don't observe the cooling effect from the low clouds on surface cooling could be related to the fact that the low cloud fraction is large over the Angolan coast (~70%), but sharply decreases in land. Low cloud cover is below 15% east of 12°E during June-September (pentads 30-54) (Dommo et al., 2018). Please see lines 271-276.

Dommo, A., Philippon, N., Vondou, D. A., Sèze, G. and Eastman, R.: The June-September low cloud cover in Western Central Africa: Mean spatial distribution and diurnal evolution, and associated atmospheric dynamics, J. Clim., doi:10.1175/JCLI-D-17-0082.1, 2018.

10. 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.

We agree with the reviewer that aerosol radiative effect might not be the sole reason for the surface temperature changes and associated high cloud cover as well as precipitation increase. We have mentioned that in the conclusion. Modeling experiments using WRF-chem are being conducted to understand the relative contribution of aerosols on such cooling, including diabatic heating, and the wet season onset over the region. Please see line 441-448:

"This study shows that aerosols may have a significant impact on the wet season onset timing over the Congo Rainforest by reducing the rainforest Ts. However, aerosols may not be the only factor behind the decrease in the rainforest Ts. As seen in Figure 4, change in the rainforest δSW_{net} (Figs. 4C and 4D) is strongly correlated with the δAOD (Fig. 4A); however, the changes in δTs (Fig. 4C) doesn't always follow the changes in δSW_{net} and δAOD and may also depend on the cloud cover. Further studies using model simulations are needed to understand the relative contribution of aerosols on the wet season onset to separate the roles of other meteorological and dynamical parameters that might also cause the reduction in Ts."

11. 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?

We have added the details in lines 221-224.

12. Provide reference wind vector in Figure 8. What is the difference between Figure 7D and Figure 8?

We have removed the plot due to redundancy because it has already been shown in Figure 7D.

13. What is SAE-J in Figure 9? Is it AEJ-S?

Corrected. Thank you for pointing these out.

14. Line 179: Remove the period after "with a"

Removed. line 187

15. Line 199: Replace “data setsc” with “data sets”

Corrected. line 207

16. Line 154: Replace “GPGP” with “GPCP”

Corrected. line 156