This study investigates the long-range transport of wildfire aerosols and their effects on cloud and radiation during an intense North American wildfire event in August 2024. Multiple sources of observations from satellites and reanalysis products have been used, especially the recently launched PACE and EarthCare. They end up with a quantification of radiation effect of fire aerosols.

The topic is of importance and it's an interesting study with a lot of work clearly done; but I believe its structure could be further improved and some sections would benefit from additional clarification. The methodology, especially the approach for isolating fire and non-fire influences (see detailed comments below), also requires refinement.

Overall I'd be positive on the manuscript if the following concerns can be satisfactorily addressed.

**Main comments:**

Introduction: To improve the manuscript's flow, the authors could include a brief preview of each section's content.

I feel the structure of the manuscript can be improved. Section 4 should be included in the result section (#3).

L278: strong vertical uplift: the positive value of vertical velocity means downward motion not uplift, which seems to contradict the conclusion drawn from the data

Fig. 2: how did the authors extract the fire-induced changes in AOD and BC from background?

L334-336: Earlier the authors stated the 4-11 um difference can identify the smoke aerosols above convective cloud-top, implying the direct effect, while here they instead attribute to the changes in cloud microphysics. They appear to be contradictory. How did the authors separate the contributions from direct effect of smoke aerosols and and indirect effect via change of clouds?

Fig. 4 shows that the smoke plume needs around 1 week to travel to Europe. It would be interesting to check if there is an obvious increase in AOD at the destinations of air parcels. This figure seems more suitable for section 3.2 than section 3.1

**Fig.7**: The authors attributed the changes in cloud properties relative to multi-year climatology to the fire-induced aerosols – I'm not sure if it's true. Clouds, particularly the convective clouds, are modulated primarily by dynamic background, then affected by aerosols via microphysical processes. The difference in Fig.7 reflects combined effects of meteorological conditions (as shown in Fig. 5) and aerosols, not aerosols alone. A good example is the similar patterns of \Delta CTH and wind field (Fig.5) on 17 Aug. Although the meteorological background on 15 Aug wasn't shown, I'd assume the strong positive anomaly at (25N, 70W) corresponds to a cyclone system, which is nothing to do with the fire-induced aerosols. Also, some suggestions/comments to this figure:

- It's not easy to follow the text with the current form of figure, as the locations of 'source region' and 'intense PyroCb development' are not obvious to readers. I suggest to mark the locations affected by fire aerosols – one can make use the information from geostationary satellites. I assume most descriptions in the text, e.g., '$\Delta$CTH exhibited marked increases of up to ~5 km', are meant for the mean value of the entire region, right? Would be good to report values only in the fire-relevant areas. Importantly, by look at the target areas, one can, at least, eliminate the confounding effect from meteorological background in non-fire regions. This suggestion also applies to Figure 10,11,12.

- PyroCb is a deep convective system that should have a cold/ice top, where CER is not relevant and cannot even be successfully retrieved from satellite. Please clarify.

- What is the motivation to select 13,15,17,19 Aug, especially when 10 Aug had the strongest fire event?

**Minor comments:**

L21-23: It's unclear if those changes appear in the PyroCbs or the downwind clouds. Please clarify.

L52: Twomey effect → the Twomey effect

L63: fires and emissions: what 'emissions' do you mean?

L64-65: the formulation is a bit confusing. The year 2024 appears to be the highest emission year, but the text seems to point to 2023..

L69: demonstrating that these fires → which, or split this sentence into two.

L71: criteria is not the right word here. I'd suggest 'providing evidence for' or simply 'supporting'

Fig.1: what does 'cloud albedo effect' (the unit is missing here) mean? Cloud albedo effect literally means the Twomey effect,; however, I don't think the Twomey effect is provided by CERES_SYN1deg-Month product. Also, how was the cloud albedo effect used to determine the study regions?

L108-109: Each instrument should come with a reference.

Table 1: Please clarify which cloud parameters are from PACE/SPEXone and what 'data' are from GOES-16/ABI and suomi (I assume it's reflectence). Also, SPEXone is designed for aerosol retrievals. I don't think it officially provides cloud properties. Harp2 or OCI would be the right instrument to look at.

L127: full name of BT/BTD

L129: what is Climate Radiative Effect (CRE)? It's not a common term to use. But looking at Eq. 5, it seems Cloud Radiative Effect but with an additional term F_cloud. Please clarify what the CRE exactly is, preferably provide relevant references where this definition comes from.

Eq. 1: is there a reference supporting this equation? Please explain the meaning of 'A' and 'N'.

L148-149: please elaborate a bit on how the fire intensity was derived and what criteria were used for fire hotspots classification.

L164-169: PM2.5 is mass concentration (ug m-3), not 'aerosol loading'. Loading commonly means burden. Also, kg kg-1 corresponds to mass mixing ratio, not concentration. I think you need to convert kg kg-1 for each aerosol species to ug m-3 before applying Eq. 2.

L255: framework → equation

Eq. 7: I didn't get the point of using spatially aggregated radiative forcing. We always use mean forcing to assess the climate effect not the aggregate one. Additionally, it appears that the term (Netpert - Netmean) is equivalent to ΔNet in Equation 6. If this is the case, please reorganize the two equations for clarity.

Lines 258-259: This metric is just a forcing term. The claim that it can constrain climate sensitivity requires further justification.

L265-266 vs L64-65: I'm even more confused which year has the highest CO2 emission. Please clarify.

Fig.2: which vertical level was selected for RH and vertical velocity?

The captions of Fig.2 (c) & (d) are incomplete. Without diving into the text, one wouldn't know what are being shown, particular if two figures are the same but only date/period differs. I also feel the figure titles are a bit misleading. Furthermore,  the definition of 'anomaly' (particularly the reference period)  is missing. Also,  firepots are missing in high AOD area, undermining the argument in L296-297.

L315-316： The aerosol, cloud, and precipitation components should be clearly labeled or described here. I didn't really see a convective system; it looks like the black band near the boundery layer is cloud part and above is aerosol. The cloud structure is not obvious in true color images in Fig.3 a & b, as UV AI masks most areas. Overlaying AI contour lines might help the visualization.

L339-L341: The claimed 'increase in albedo' in Figure 4 is not visually apparent. A quantitative metric would help.

Fig. 5: Please explain what the red line means in the caption and mark the fire regions in the plot.

Fig. 6: Table 1 shows CO is from TROPOMI while here authors stated it's from MERRA2. Please correct the wrong one.

L386：  latitudinal → longitudinal

Fig.9: Are the date from SPEXone as well?

L458-469: Using the simple temporal evolution of regional means to explain cloud fraction responses is too simplistic. Especially, the 5-day delay of response of CF is unusual. I suggest to omit the discussion on cloud response if there is no strong evidence. Similarly for L471-475, the Twomey effect is also not justified here without showing CDNC results.