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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Chemical composition, optical properties and radiative forcing efficiency of nascent particulate matter emitted by an aircraft turbofan burning conventional and alternative fuels" *by* Miriam Elser et al.

Anonymous Referee #3

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This paper provides details of the chemical composition and the optical properties of the particulate matter (PM) measured at the exit plane of a CFM56-7B engine burning four blends of Jet A-1 and HEFA fuels. The paper itself is an important contribution to the literature in terms of characterizing the chemical and optical properties from an aircraft engine burning fuels with varying composition. The paper is well written but has several deficiencies that must be addressed by the authors. Chief among them is how the authors calculate the direct radiative forcing.

General Comments:

The measurements reported in this paper were performed at ground level behind the engine exit plane, but the authors have not adequately discussed the impact of different temperature and pressure regimes at cruise levels on optical properties.

Also, the impact of plume evolution at cruise conditions had not been discussed. The authors' goal of coming up with radiative effect of aircraft particulate emissions falls short in this regard.

Specific comments:

Pg 1, Ln 3: The authors switch between "aircraft particulate emissions" and "aircraft exhaust aerosol". Please be specific and consistent.

Pg 1, Ln 19: I'm not sure what "The separation of elemental carbon (EC) and organic carbon (OC)" means? Please clarify

Pg 3, Ln 25-26: Moore et al., 2017 reports on the emissions from a 50:50 blend at cruise. Please update the text to include the engine type and fuel since you have previously stated that these are important factors. Please also state that the reductions were measured at cruise levels.

Pg 3, Ln 28-29: The authors mention the engine type in the abstract. It should also be included here.

Pg 7, Ln 7-10: I don't see how you can assume that the difference in optical properties at altitude compared to ground level conditions are minor when you don't have any supporting evidence. Also, the study cited was for PM size distributions, and not nvPM size distributions.

Pg 7, Ln 13-14: The authors state "Additional measurements are therefore required in order to assess the plume evolution of aircraft emissions in the atmosphere." However, there are several studies that have reported plume evolution of aircraft engine emissions. These studies have shown a dramatic change in PM size distributions from exit plane measurements. How do the authors reconcile their approach with this published

literature data?

Pg 8, Ln 22-23: “the decrease due to the 32% HEFA blend was highest at low thrust levels”. Other studies have also reported that the largest decrease was observed at low thrust levels. Can the authors comment on why this is generally the case?

Pg 8, Ln 27-33: Can the authors put the SSA results in context with measurements from other combustion sources?

Pg 9, Ln 23-24: Diesel engine emissions are significantly different from those of aircraft engines, in terms of size, density, EC/TC, etc. Is there a more appropriate source to estimate backscattering?

Pg 10, Ln 8-22: The authors are using engine exit plane measurement data for SFE estimation, and do not consider the cooling effect of sulfates. This section should either be supported with additional data or removed from the paper. Also, no information is presented on the impact of using blends of HEFA with Jet A-1 on radiative forcing.

Pg 16, Table 1: It’s surprising that the Jet A-1 and 10% HEFA fuels have similar hydrogen content by different aromatic contents. Since the Jet A-1 is blended with HEFA, shouldn’t the hydrogen content for 10% HEFA be higher? Likewise with the 5% blend, where the hydrogen content is lower than that of the unblended Jet A-1. Can the authors explain?

Pg 16, Figure 1: What is APC? It has not been previously defined.

Pg 17, Figure 2: Panel (f) is an interesting result (no difference in OC/TC for Jet A and 32% HEFA). Is this result unique to the fuel tested or have there been similar observations in other studies?

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-1171, 2018.