

Final Author Reply to the Editor (2nd Round)

Caleb Akhtar Martínez, Sebastian D. Eastham, and Jerome P. Jarrett

Dear Prof. Martina Krämer,

We are very grateful to you for your consideration of our manuscript, and to the referees for their second round of constructive feedback. These comments have further enhanced our scientific rigor and analysis. Our detailed responses to each point are provided below.

As in our previous response, we are using the following structure: (1) Referee Comment; (2) Response; and (3) Changes in Manuscript. All changes have been marked in the revised version for ease of reference. In this revision, we have addressed the minor comments highlighted by the reviewers, and we do not believe there are any changes that require highlighting.

We hope that the revised manuscript now meets the expectations of the reviewers and ACP, and we respectfully submit it for your consideration.

Sincerely,

Caleb Akhtar Martínez, Sebastian D. Eastham, and Jerome P. Jarrett

Responses to Anonymous Referee #1

“L 105 and 106: Is it actually "m depth" or rather "m of flightpath"? The latter would sound more familiar to me.”

Author’s response: We are grateful for this comment and agree that stating “m of flightpath” causes less confusion.

Author’s changes in manuscript: Changed “m depth” to “m of flightpath” on line 108 of the revised manuscript.

“L 110: I assume, r means the radius of the ice crystals. This should be written.”

Author’s response: Agreed. We have now clarified this in the manuscript.

Author’s changes in manuscript: Clarified that r refers to the average ice crystal radius in line 112 of the revised manuscript “of order r – the average ice crystal radius”.

Responses to Anonymous Referee #3

“Fig. 2: what is the cruise altitude in the used coordinate system? Please add this information in the caption or plot.”

Author’s response: The cruise pressure altitude in Fig. 2 is 10000 m. We agree that it would be beneficial to add this in the caption.

Author’s changes in manuscript: Added “The origin of each panel represents the approximate visual center of the contrail, at a pressure altitude of 9927 m in CoCiP and 9750 m in APCEMM. The cruise altitude is 10000 m.” to the caption of Fig. 2.

“Line 105: not sure if ,m depth‘ is appropriate here. You should better explain that your quantities are given per unit length along flight distance.”

Author’s response: Agreed. This has been changed in the revised manuscript.

Author’s changes in manuscript: Changed “m depth” to “m of flightpath” on line 108 of the revised manuscript.

“,Weather data‘ in the green bubble in figure 3 is (still) misleading as your meteorological background conditions are very idealised scenarios and weather data in my opinion implies that you use NWP data or something similar.”

Author’s response: We are grateful for highlighting this oversight and agree that Figure 3 should also be changed to reflect the use of synthetic meteorology.

Author’s changes in manuscript: Changed the text in the green bubble in Figure 3 from “Weather data” to “Synthetic Meteorology”

“You present a new type of analysis in section 4.1.3, which is in general a nice approach. However, I am not sure how meaningful it is in the present form. In Eq. 6, the error could be zero, when the under/overestimations cancel out by summing over all cases. Would it not make more sense to sum up the absolute values of model differences?”

Author’s response: We agree with the perspective shared here and we have concluded that the analysis would be clearer to the reader if the absolute value is used in lieu of the signed error.

Author's changes in manuscript: Replaced the brackets in Eq. 6 with absolute values. There are no changes in the results because the time-integrated total extinction is greater in APCEMM than in CoCiP (at all times) in all simulations.

“Moreover the reasoning around line 345 is not very rigorous. Contrail lifetimes of 4h and 8h occur in other meteorological scenarios than you studied. Hence it is speculation how model differences would look like in such atmospheric scenarios. Contrail sublimation due to subsidence may occur at different rates in the two models. Hence $\Delta(4h)$ of your simulation set does not capture this.”

Author's response: It is true that the reasoning presented in line 345 is speculative. We agree with the points raised in this comment, and we have adjusted our choice of language to reflect the speculative nature of the analysis.

Author's changes in manuscript: Changed “However, they also indicate that our findings are particularly relevant to those 6–7 % of contrails that persist beyond 8 h” to “We also hypothesize that our findings could be particularly relevant to those 6–7 % of contrails that persist beyond 8 h” in lines 348-349 of the revised manuscript.

“Around line 450 and in some prior text parts, you state that the long contrail lifetimes observed in your scenarios may match observations of contrails with the greatest warming to highlight the relevance of your results. Given that your strongly idealised background conditions use a rather academic time-constant RHi I suggest to not overstate the conclusiveness of your comparison. Similar lifetimes do not guarantee that your scenarios are good proxies for strong-contrails scenarios.”

Author's response: We agree that our outlooks are speculative and have adjusted our language accordingly in Sections 3.2.1, 4.1.3, and the conclusions.

Author's changes in manuscript:

In the conclusions, we changed “Since Gierens and Vazquez-Navarro (2018) found that ~6–7 % of contrails persist beyond 8 hours, this makes it likely for the conceptual findings from this study to be applicable to the real contrails with the greatest warming.” to

“Since Gierens and Vazquez-Navarro (2018) found that ~6–7 % of contrails persist beyond 8 hours, it is possible that the conceptual findings from this study could be applicable to the some of the real contrails responsible for most of the warming. Nevertheless, further comparisons using more realistic meteorology are needed to validate our findings and to reveal the extent of their applicability.” in lines 455 to 458 of the revised manuscript.

In Section 3.2.1, we added the following sentence “Nevertheless, the extent of the applicability of our findings on real contrails will need to be determined through further experimental and computational work” to line 277 of the revised manuscript.

In Section 3.2.1 we also replaced “likely including some of the contrails” to “perhaps including some of the contrails” in line 276 of the revised manuscript.

In Section 4.1.3 we changed “However, they also indicate that our findings are particularly relevant to those 6–7 % of contrails that persist beyond 8 h” to “We also hypothesize that our findings could be particularly relevant to those 6–7 % of contrails that persist beyond 8 h” in lines 348-349 of the revised manuscript.