

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2022-222

Anonymous Referee #2

Referee comment on "Impact of present and future aircraft NO_x and aerosol emissions on atmospheric composition and associated direct radiative forcing of climate" by Etienne Terrenoire et al., Atmos. Chem. Phys. Discuss.,
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Review of the "Impact of present and future aircraft NO_x and aerosol emissions on atmospheric composition and associated direct radiative forcing on climate" by Terrenoire et al.

This study explores and gathers various aspects of the impact of aircraft NO_x emissions on atmospheric composition and climate utilizing a series of present and future aviation projections, and an updated global chemistry-aerosol-climate model, LMDZ-INCA. In addition to the well-established effects of aircraft NO_x emission, this paper also investigates the impacts that arise from the formation of nitrate and sulfate aerosols that constitute a novelty of the publication as it has been addressed in only a few modeling studies so far. It is also associated with large uncertainties, which might be worth highlighting more in this publication.

The paper is well-written and scientifically sound. The applied methods are valid and clear. The findings of the study are of interest to the community. I recommend this paper for publication, preceded by a few minor comments.

General comments:

Abstract reads more like a summary. It is too long, with too many technicalities, and it is difficult to follow. I would suggest authors consider re-writing it, concentrating on the main findings and their implications.

The text is full of details, which on one side is understandable taking into account the number of experiments that were performed for this study. On the other hand, maybe authors can help to level this complexity of the paper by preparing a kind of 'takeaway figure'. Figure that would summarize the main results, highlight the novelty of this study, etc. I believe the paper might gain the readability by having such a figure, but I leave this decision with the authors.

Specific comments:

Lines 90-94: some references can be useful here

Line 219: motigtaion ---> mitigation

Line 239: the list (e.g., as a Table) of performed experiments, maybe with their short description, might be helpful

Lines 464: why your "present-day" is 2004 here, while in the previous section is 2006?

Line 490: the description of methane RF calculation and all the methane-induced components are missing? Maybe part of your section 6.2 can be moved to 3.4, or vice versa, for consistency.

Line 528: Figure 5 (and subsequent Figures) why May? Why not July, or JJA? On the other hand, your RF numbers are based on annual averages, so maybe your chemistry analysis can show the annual means too?

Line 657: since you discuss the future scenarios run with interactive chemistry, it would be interesting to know how future climate change might influence your results. What is the sensitivity of aviation forcings to future climate? Is the use of present-day meteorology justified here?

Line 682: wouldn't it be more suitable to discuss the effects of the mitigation scenarios based on the annual change, not a one-month response?

Line 795: 7.2 ---> 7.3

Line 833: having fixed surface CH₄ concentrations means your CH₄ and OH interactions are constrained, so it is not obvious how you derived your CH₄ feedback factor.

Line 875 and Table 5: your long-term ozone estimate is much smaller than what can be found in other studies, e.g., 47% (Wild et al., 2001), 58% (Kohler et al., 2008), 42% (Hoor et al., 2009), 51%, 43% (Pitari et al., 2016) of the CH₄ RF. Most of the latest aircraft studies include 50% (IPCC AR4, Myhre et al., 2013) in their calculations. The same applies to your stratospheric water vapor; most studies calculate it to be 15% (Myhre et al., 2007) of the CH₄ RF, while yours is around three times smaller. These need some clarification or/and justification.

Line 906: based the Etminan ---> based on the Etminan

Line 946: and 2004 ---> and 2005

Line 888 and Table S3: the CH₄ increase via the Etminan parametrization you report is 15%, and it is smaller than what other aircraft studies calculate (e.g., Grewe et al., 2019), Skowron et al., 2021). Any explanation for that? At the same time, a few paragraphs above (line 822), you mention the 24.5% increase. It is confusing.

Line 1055: considering significant uncertainties associated with ERF/RF factors (especially those related to NO_x as based on just one study according to Lee et al., 2021), wouldn't it be better to compare RF numbers? It would also be consistent with Holmes et al. (2011) comparison. Another aspect is the nature of these studies, Lee et al. (2021) and Holmes et al. (2011) are multi-model ensembles, so maybe presenting also ranges that they report together with their best estimates might help your comparison to be more feasible.