

Review of revised version of “Impact of future aircraft NOx emissions on atmospheric composition and climate: dependence on background conditions”, by Zosia Staniaszek et al.

General comments

Thanks for the revised manuscript and I apologize for taking so long to look at it. The revisions have improved the paper, but I do still have some suggestions for further clarification (I think these are all fairly straightforward) – see specific comments below.

If these can be responded to, then I am happy to recommend the paper is accepted.

Specific comments

Table 2/L148: I suggest you include the prescribed CH₄ lower boundary condition mixing ratios for each simulation in the table. The values for the two SSP scenarios in 2050 are in the text, but I didn't find the value used for the present-day simulations. Also – is this a single global mean value (I assume so), or do you apply some latitude dependence (e.g., as observed)?

L131 Table 2 caption: change to “...perturbed (reduced) by 20%...”

L144: Say “global annual mean” (change in methane mixing ratio).

L149: I understand your pragmatic approach of using a model mean value for $f_{feedback}$. But it is probably worth noting (here and/or in the later discussion), that this factor is likely to be different in each model – and is another contributor to model differences. You perhaps have not done the experiments to know how f varies between your models, but my suspicion is that this may well introduce significant inter-model differences to your results. Perhaps note as another aspect of uncertainties and further work.

L148/L159 Equation (1): [CH₄]_{SSP}. You define this as the ‘methane reference mixing ratios in 2050’, but Equation (1) must also be used for calculating the present-day impacts on methane of the 20% reductions in aviation (simulation 2 vs simulation 1)? (Actually, maybe this methane change is never calculated – PD short-term O₃ RFs are in Figure 2, but Figure 5 only calculates the net aviation NO_x RF for the future scenarios). My recommendation would be to additionally include the PD CH₄ RF values somewhere, and rename [CH₄]_{SSP} to [CH₄]_{REF}, to make it generally applicable.

L143-174 Overall, although the description of how methane is handled is improved, I still found it quite confusing, and I needed to very carefully read this section several times to work out exactly what you had done. In addition to the previous comments, I have a few other recommendations:

I suggest include a new table (Table 3) with details of the inferred CH₄ perturbations, something like:

Experiment	[CH ₄] _{REF} (ppbv)	$\Delta\tau_{CH_4}$ (%)	ΔCH_4 (ppbv)	[CH ₄] _{perturbed} (ppbv)	RF _{CH₄} (mW m ⁻²)
REF_PD	1800	-	-	-	-
PD_Air-20	1800	+1	+100	1900	-20
Etc.					

L164-166/Equation (2): As I suggest above, I would be explicit about the methane values, and rename/clearly define:

[CH₄] -> [CH₄]_{perturbed}

[CH₄]_{SSP} -> [CH₄]_{REF}

$$[\text{CH}_4] (\text{bar}) = ([\text{CH}_4]_{\text{perturbed}} + [\text{CH}_4]_{\text{REF}}) / 2$$

L172: I wasn't quite clear on the efficacy used for the long-term ozone forcing (associated with the methane forcing) – is this also 1.370, or does this come under “indirect forcings” and so is 1.180? My question really relates to what the efficacy (or ERF/RF ratio) depends upon – is it the gas, or is it a combination of the gas and the spatial/temporal structure of its change in distribution? I suggest briefly discuss and better justify your choices.

L189 Clarify if ‘background emissions’ refers to total anthropogenic NO_x emissions, or all NO_x emissions (including natural sources).

L197 Clarify the vertical profiles in Figure 2b are global annual mean changes in distribution.

L204 “baseline”: You mix baseline and background and these have subtle differences in meaning. I suggest you try and consistently use background.

Figure 2b: Suggest add a vertical zero line for clarity.

Figure 2b caption: Add global annual mean

L214 gradient between the stratosphere and the troposphere?

L268 negative sensitivity to SSP1 -> lower sensitivity for the SSP1?

L293 are scenario-specific

Discussion of Figure 5: My reading of Figure 5 is that the net RF from NO_x is approximately zero (I think if you had error bars on the net values they would all cross zero). I think this could be more clearly stated in the conclusions (I do think that someone could usefully say: after decades of work with multiple models, we can probably all go home and just worry about the aircraft CO₂ emissions, and forget about the NO_x, but I appreciate that is a bit sweeping and controversial!)