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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Coupled Chemistry-Climate Effects from 2050 Projected Aviation Emissions" *by* Andrew Gettelman et al.

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This paper calculates the non-CO2 climate impacts of future aircraft emissions using two very different models. There are some reasonably robust changes in radiative forcing from the CESM model, but the changes in temperature are not found to be robust. Overall it is not clear what the new findings coming from this study are. The work is publishable, but more thought needs to be given to the overall messages if this paper is to be of interest to the community.

The two models are set up differently which makes it very difficult to draw any useful conclusions from their comparison. In particular the absence of radiative forcing data from GATOR-GCMOM means that the conclusions in section 5 are mostly speculative. Ideally both models would also have run fixed-SST experiments to categorize the rapid

responses.

In general the text doesn't flow very well, with many short paragraphs that don't seem to connect. It would help to understand the messages better if there was a logical chain of argument that could be followed.

Specific points:

Page 2, line 11: I'm not sure describing the aerosol effects as 'non-linear' is a helpful term. None of the aircraft impacts are strictly linear.

Page 2, line 23: "and RF increases by . . .". This clause doesn't seem to sit with the rest of the sentence.

Page 5, line 9: What is meant by "Ensembles are created with a unit temperature perturbation"?

Page 5, line 25: I presume the fluxes are taken at the tropopause because there is no stratospheric adjustment? Does this give equivalent results to a RTM with stratospheric adjustment?

Page 7, line 32: "non-linear" isn't the right term.

Page 8, lines 20-24: Surely the model can tell you whether there are fewer present day contrails, or a higher change for forming contrails?

Page 8, lines 30-34: Presumably the aerosol emission affect the contrails as well, which should be discussed here. Why are the differences between scenarios 2 and 3 not statistically significant? If they are run with specified dynamics the meteorology should be the same and hence no (or very little) variability. I don't understand why the effect of water vapour emissions is so small. According to figure 1A the water vapour alone has a huge forcing.

Page 9, line 7. The effect of alternative fuels here doesn't seem the same as the difference between the lines 2050-S1 and 2050-S2 in table 2. In particular in the table

the effect on O3-S is 12.0 mW/m2 which seems large. The authors should explain how the changes in sulfur and BC cause such a large change in ozone.

Page 10, lines 1-5. Which scenarios do these forcings come from?

Section 3.2.3: Given that it isn't expected that the aerosols affect ozone I suggest this (very short) section isn't needed, nor are figures 3A and B, or 6 A,B,C.

Section 3.4: Should this be numbered 3.3?

Section 3.4.2: The arguments in this section needs to be made clearer. Figure 2D needs to be the 5-year result from CESM for like-for-like comparison with GATOR. The time evolution needs to be discussed in relation to rapid responses to composition followed by slower responses to SST evolution. It is not clear what the message of the second two paragraphs is. Description of the physics should be moved to section 2, unless the authors are specifically contrasting the different effects of the physics in GATOR and CESM.

Page 12, line 10. "...contrail radiative forcing dominates..." I don't see why this is true, don't scenarios 1 and 2 have similar contrails?

Page 13, line 1. Where does GATOR show a small warming? In figure 4 it cools.

Page 13, lines 11-13: I didn't see the relevance of this disconnected paragraph on Righi et al.?

Page 13, line 15-16: This disconnected paragraph needs to be moved somewhere else as part of a logical train of argument.

Page 13, lines 20-34: Much of this is model description which could be moved to section 2. Earlier (page 12, line 30) the BC and sulfate are described as externally mixed in the exhaust, but here they are described as internally mixed.

Page 14: These short paragraphs disrupt any flow of argument. What is the message of this section?

Page 15, line 11-12: The forcing in GATOR needs to be shown to back this up.

Page 15, lines 17-20: The difference between the baseline (-0.11K) and the AltFuel (+0.1K) is 0.2K. While this may not be statistically significant due to the length of the simulations, this is not a negligible difference compared to the 1.5-2.0K Paris recommendations.

Section 5: The paragraphs in this section tend to be short and unconnected which makes it difficult to pull out the important messages of this study.

Figure 2: A different set of contour levels is needed to show the ozone changes.

Figures 3, 5, 6: The ozone panels don't add information here.

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