

## ***Interactive comment on “The global impact of the transport sectors on atmospheric aerosol in 2030 – Part 2: Aviation” by M. Righi et al.***

**Anonymous Referee #3**

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Review of the paper “The global impact of the transport sectors on atmospheric aerosol in 2030 – Part 2: Aviation” by M. Righi et al.

The paper describes four different scenarios of aviation induced emissions in 2030 and their impacts on atmospheric aerosol concentrations and subsequently on climate. The authors consider direct and indirect effects of the aerosol emissions and they give uncertainty ranges of their findings.

This is a nice study on the possible effects of air craft emissions on atmospheric aerosol concentrations and climate. It is well designed and the applied methods are appropriate and state of the art. Besides some clarifications that need to be done and that are mentioned later, my main concern is about how the emission scenarios were constructed and how they are connected to the RCP scenarios of IPCC. To me, and I would

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suppose that this will be the case for most readers, it is very surprising that BC and SO<sub>2</sub> emissions from aviation increase most in the RCP2.6 scenario, which is the most optimistic IPCC scenario in terms of lowest changes in radiative forcing. In addition, it is hard to understand why RCP6.0 globally shows the lowest increase in BC and SO<sub>2</sub> emissions until 2030.

I can follow the explanations that are given about the construction of the emissions between lines 11 and 23 on page 34042, however it seems to me that they were not constructed in a consistent way. While RCP 4.5 and RCP8.5 are based on older inventories developed in QUANTIFY, RCP 6.0 and RCP2.6 were constructed in a different way (and not the same way for both). Why couldn't you construct the RCP2.6 and RCP6.0 in the same way as it was done years ago for RCP 4.5 and RCP8.5? And if you have to construct two new scenarios, because they were not available in QUANTIFY, why don't you do this in a consistent way for both of them? In addition, the BC/NO<sub>x</sub> ratio is by far the highest for RCP2.6. You say this is the case, because the aviation share for BC in QUANTIFY is largely increasing between 2000 and 2030 (page 34042, lines 11 -23). How is this justified from a technological point of view? You claim that there won't be much technological development in the coming decades related to the aircraft turbines. So why is the BC/NO<sub>x</sub> ratio much higher in one of the scenarios compared to the others? In summary, I think that at least the naming of the scenarios following the RCP scenarios is misleading. Additionally, the way how they were constructed and why this was done needs far more justification than is available in the paper now. I would favor publication of the manuscript, but some major changes need to be done.

Major comments:

Title: I am aware of the fact that two papers were already published with the same main title. However, this study is on atmospheric aerosols and climate, which could have been mentioned in the title.

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page 34038, line 19-21: You mention short lived gases and aerosol precursors. NO<sub>x</sub> are important emissions from aviation and they are shown in Figure 2. I am missing a discussion on the effects of NO<sub>x</sub> on particle formation and ozone.

page 34040, line 22-26: If the RCP scenarios are not well suited for air quality projections, why are they used, here?

page 34041, line 25: Why didn't you consider the introduction of low sulfur fuels in your scenarios? I would assume that this would reduce the indirect cooling quite substantially. Therefore it would be a very interesting case.

page 34042, lines 11 -23: see my comments above on the construction of the scenarios.

page 34057/34058: Why are the BC and SO<sub>4</sub> concentrations from all other sectors (right column in Figures 3 and 4) so different in RCP6.0 compared to the other RCPs? Since this is your background and your reference for the aviation effects, you might need to briefly explain the reasons for the differences.

page 34044, line 12-13: sulfate should increase in the same way as BC in RCP2.6. Why isn't this noticeable?

page 34044, line 23-24: "it should be questioned whether the assumptions of high aviation emission shares in RCP2.6 are realistic RCP2.6 is unrealistically high": This is the point. Is there really a good reason why they were constructed this way? Then you need to explain it.

page 34044, line 25-27: Are there effects of NO<sub>x</sub> emissions on nitrate formation?

page 34046, line 6 and Fig.8: It would be nice to have the numbers for the radiative forcing given somewhere. Some are mentioned in the abstract but not here.

page 34047, line 8-9: "seems to support ...": How do you see this in Fig. 6?

page 34047, line 13-14: Are these numbers calculated by Unger et al. comparable to

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some of your numbers, e.g. to the clear sky RFs? How do they compare?

page 34047, line 13-14: "... with RCP2.6 being the most extreme one." Extreme in which way? Typically, one would expect that RCP2.6 is most extreme in emission reductions, here it is the other way round. This needs explanation.

page 34048, line 15-17: "Future policies addressing the aviation sector should therefore focus on reducing its climate impact.": This is very general, could you be more specific? It looks like a sulfur reduction would reduce cooling, however, you would also reduce BC emissions which probably have warming effects? Can that be distinguished from your study?

Minor comments:

page 34036, line 22-24: "more than doubled": 63 is more than four times 15. Maybe you add "in all scenarios" after "-15 mW<sup>-2</sup>".

page 34037, line 7: "small fraction". I do not think that 2.6% is a small fraction for just one transport sector. This is in the order of all sectors from a big industrialized country like Germany.

page 34038, line 13-15: "simulate the aerosol cloud and aerosol radiation interactions": please explain, here or somewhere else, which interactions are considered and which potentially important ones not.

page 34040, line 15-16: Which aerosol quantities (number, mass, ...) were represented "reasonably good"?

page 34042, line 4: explain CMIP5

page 34042, line 7-8: why are the relative changes only similar and not equal?

page 34046, line 11-13: rescaling means using the same percentages? Then you should write "same relative uncertainty" in lines 12-13. page 34049, line 21: aerosol

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number concentration, mass concentration or both?

Typos

page 34040, line 7: layers

page 34044, line 6: particles

page 34047, line 5: mechanisms

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Interactive comment on Atmos. Chem. Phys. Discuss., 15, 34035, 2015.

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