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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Climate and air quality impacts due to mitigation of non-methane near-term climate forcers" *by* Robert J. Allen et al.

Anonymous Referee #1

Received and published: 16 February 2020

General:

Allen et al. introduce results of the AerChemMIP project on the impact of air quality measures on climate. This is a large exercise and certainly worth publishing. However, I think there are major shortcomings. The most apparent is the style. The paper is written as a report, stating what has been done and what is the outcome. While this is, of course, an essential part of a paper, it should contain much more. It is less written as a scientific paper that should motivate chosen assumptions, extract main new massages from results, and discuss uncertainties e.g. wrt. to the chosen assumptions. This is largely missing. For example the main message "Our findings suggest that future policies that aggressively target non-methane NTCF reductions will improve air quality, but will lead to additional surface warming" is shown in the end

as being nothing new, but already covered by many other studies, as shown by the authors in line 345ff. So what is new? And this puts me actually in a difficult position, why should a paper be published which "just" confirms previous findings? I understand that IPCC deadlines have to be met, but more emphasis should be given to clearly describe what is new. More examples are given in the detailed comments below.

Major comments in addition to the writing style:

1) Structure: The method section is too short:

- More information on statistics should be given (see details below); Please explain why the multi-model trends are significant, although individual model trends are not. What trend model has been used? What exactly is tested?

- A motivation why exactly these climate/air quality/extreme indicators are chosen is missing;

- Part 3.1 is actually input to the study and should be moved from the results part to the method part.

2) Statistics: I have strong concerns how the statistics are interpreted. If a difference is not statistical significant, there is no basis in discussing them. Please remove all parts, which interpret statistically insignificant differences.

3) Discussion: How important are the choices made in the assumption section?

Detailed comments:

Abstract: "How future policies affect the abundance of NTCFs and their impact on climate and air quality remains uncertain." I am wondering whether this could be misunderstood in a way that for a given measure the impact remains uncertain. Most of the uncertainty comes from the uncertainty what measures will be taken, right?

l13 "similar increases" what means similar here? Can a extreme weather index be similar to a temperature increase of 0.24 K? or is even 0.34 K similar to 1.1%. Please

specify.

l16 "ozone reductions.": I think it would be helpful to include half a sentence explaining the relation between aerosols and ozone.

l20-21: I think the definition in Myhre et al 2013 is "We define 'near-term climate forcers' (NTCFs) as those compounds whose impact on climate occurs primarily within the first decade after their emission." It reads a little bit different from "that impact climate on relatively short time scales, typically within a few weeks to a decade after emission" Climate is defined on decadal timescales. To relate climate change to to weeks sounds weird. Concentration changes and RF can quickly react, but you started to discuss climatological changes in temperature and rain rates and those do not occur on weekly timescales. Please adapt the text.

l28 should it be "-2.0 to -0.4" ?

l34 shouldn't methane be mentioned here as well, since it is a precursor for ozone? I think you are referring to table 8.6 in Myhre et al. 2013. Their tropospheric ozone are a total ozone change and include effects from methane emissions.

l34-37: Here you change from a concentration perspective (ozone) to an emission perspective (methane). Please clarify this, otherwise it seems to be inconsistent and double counting methane ozone effects. Especially the wording "Similarly," should be revised, since the view is exactly not similar.

l42-44 please clarify the sentence. How can a change in radiation, i.e. in W/m2, be balanced by evaporation in units m/s.

l62 please clarify what you mean with "rapid". See also discussion above.

l91 You mean the scenarios you are employing. ...

Section 2.1: I think it would be nice to have a motivation included. Currently, it reads like a report or namelist setting. Why is the reference without climate policy? etc. this

should be motivated.

Please also include a table showing the changes in relevant emissions, such as aerosol compounds and ozone precursors for some well-chosen times, e.g. 2015, 2035, 2055; or decadal? I think it is important to see the changes.

l120 I find the abbreviation misleading. "lowAER" and "lowAERO3" are model group names. "low", however, is not referring to the models, but to the scenario, right? and at some point I though "AERO3" is the "AEROsol Group 3" and not aerosol-ozone. What about "Only-Aer" and "Aer-O3"; or "Aer+O3" ?

l135 Please include what kind of linear model you are using y(t)=a+bt+err or y(t)=b(t-2035)+err ? Are you fitting one or two parameters? Often as a measure for the fitting quality the Rˆ2 value or adjusted Rˆ2 value is used. Why not here? I do not understand how the trend is tested. Are the individual model results fitted and then tested whether the mean trend is representing the range of models correctly? (At least the caption of Figure 7 might indicate something like this). How the statistics are treated is very important for the interpretation. Please include a thorough discussion here.

l159 Also here a motivation is missing. I understand that extreme values are important. But why is the max temperature chosen? Isn't that a statistically very difficult quantity, even among extreme value statistics? Why not using number of hot days, i.e. over 30°C? This also concentrates on extremes, but includes a whole tail of a pdf (or estimated pdf).

l162 please also add the respective time frame. Are you averaging over 10 or 30 years?

l165ff: I would have expected this part in the scenario section. Please consider to move it there, since this is not a result from your paper, right? And then ignore my comment on the table (see above) ...

l167: Why is there a CO2 emission change at all, if you are considering NTCF changes only? Please explain. I don't think that this is a problem, but currently and certainly it

confuses me.

l192: Why are you discussing methane emission changes, if those are not relevant?

Figure 2: Trends are calculated as (2055-2015)/4 or with the regression method discussed in Section 2?

l 205: Please comment if the trends of the individual models are statistical significant. I miss a mathematical/statistical explanation in combination with a motivation why to test the multi-model mean and not, whether mean trend is significant wth respect to the variation in trends of the individual models.

l 206: For the regional trend an uncertainty range is given. Why not here?

l213-l214: If a result is not statistical significant, there is no point in interpreting the result. Please delete the sentence.

l223: Keep in mind that the change was not statistical significant; so the results may not be inconsistent, but only noise. Please revise the discussion, based on what is inconsistent on a statistical significant basis.

l 246: "Slightly larger (but not statistically significant) "; if not statistically significant, then they are not slightly larger! Please respect the statistics.

l263-264: Please rephrase the sentence. I agree with the content, however, the formulation, starting with "however" suggests that there is either a shortcoming or something unexpected, etc. As the authors state this is by no means a surprise nor limitation of the aforementioned.

l262 I think somewhere it should made clear that a part of the warming is a reduced cooling from SO2 reduction and O3 reductions, right?

l284 Is there some relation to the monsoon tipping points?

Section 3.4: What about MAM/SON? Discussed are winter/summer differences. How-

ever, "Seasons" would imply more than that. I suggest to, at least, mention a general trend for MAM/SON and add the same figures in a supplement.

l339-342: This is important: see also above. If the difference is not statistical significant, there is no point in discussing or even highlighting it in the summary. Please remove this part!

l359: It might be worth mentioning reduced warming, i.e. a net cooling. To avoid confusion about weather CH4 itself has a cooling contribution.

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