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Interactive comment on "Ozone sensitivity to varying greenhouse gases and ozone-depleting substances in CCMI simulations" *by* Olaf Morgenstern et al.

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(In the below, our replies to the reviewer's comments are in bold.)

This paper presents results from simulations, coordinated under the CCMI-1 initiative, performed from a number of chemistry climate models. These results have an interest to the climate community at large as they outline how the simulated ozone field in these different models is impacted by changes in a number of forcings, i.e., CH_4, N_2O, Cl^{eq} and CO_2^{eq}. The CCMI-1 initiative should provide ozone climatologies to climate models that use prescribed ozone fields in CMIP6 simulations, and this paper outlines the robust or non-robust features of these climatologies. The paper is relatively clear

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in its presentation of the objectives, the method used, the results. I think that on the basis of these results adding in this paper some recommendations with regards to the production of these climatologies would improve the interest of the paper.

I recommend publication of this paper in ACP.

We thank the reviewer for these encouraging comments. We have now added a section on the implications of the findings for generating ozone forcing fields for climate models that to not predict ozone.

Please find below my comments, questions and remarks, first the more important ones and then the minor ones.

- line 26 and line : "there is a requirement for a robust mechanism...": As indicated in my summary of the paper, the paper would gain including indications for this robust mechanism.

  See above.

- line 94: Please describe how the various gases are grouped into CO_2^{eq}.

  This is now described in sufficient detail. Basically, the gases that make up the RCP scenarios are weighted with their radiative efficiencies and summed up. It is worth noting that this is a diagnostic approach only. The various models considered here actually use various subsets of the gases considered here in their radiation schemes, and variably use or do not use lumping to account for those gases not included in these schemes. However, in all cases CO_2^{eq} is only marginally larger than CO_2.

- line 142: "and references therein": it would be useful to have here a synthesis of the main differences between these models that could have an impact on the results analysed in this paper.

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We now attempt to do this. However, this is a pretty big task so this discussion remains fairly superficial. However, we now add a discussion on the sensitivity of age-of-air to the forcings studied here, which provides more insights on the possible causes for the differences in behaviour.

- line 154: I would think that the comment here is somehow misleading. Even with prescribed or only partially interactive tropospheric composition there is a response of ozone in the stratosphere to surface methane changes as for instance is illustrated in Figure 1 for the CCSRNIES model. Therefore there should be a response of the total-column ozone. Please clarify this paragraph.

  That is correct. With prescribed ozone in the troposphere, a significant part of the response in total-column ozone is suppressed (and all of the surface ozone response). This skews the comparison of the response with the other models that have interactive tropospheric ozone. However, in response to this comment we now show the total-column response also for the two models in question, CCSRNIES-MIROC 3.2 and UMSLIMCAT.

- line 161 equation 1: the text specifies line 171 that ΔCH_4 is the global-mean methane mixing ratio. Shouldn't it rather be the global-mean surface methane mixing ratio? Please specify similarly what is ΔN_2O, ΔCl^{eq} as you in particular indicate that Cl^{eq} is shifted by 4 years, and ΔCO_2^{eq}.

  Indeed. In all cases, the forcing fields are as applied at the surface. We have now replaced "global-mean" with "global surface mean".

- line 207: "relatively pronounced negative feedback" is not so clear in Figure 1 for WACCM. Please modify the comment.

  We have now rephrased the whole paragraph; this formulation no longer appears.

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- line 238: "whereas CESM1-WACCM, NIWA-UKCA, and SOCOL3 produce partly insignificant decreases in most regions": If the change appears in white in the figure, how can you conclude that it is a decrease or an increase? And according to figure 4, CMAM has larger areas with non-significant results than NIWA-UKCA. Please amend the comments in the text.

  We have rephrased the paragraph in response to this comment.

- line 239: "In CMAM ...": I don't agree with this statement: from 100 to 1 hPa Figure 4 shows significant large decreases of ozone when N_2O increases.

  This was meant to refer to the region above 1 hPa. This detail is now added.

- In all figures with presentation of the NIWA-UKCA model please convert the vertical coordinate from km to hPa. What you will then present will be a better approximation then what readers would obtain doing it at glance in order to compare the NIWA-UKCA results with the results of the other models.

  In all affected plots, we have interpolated the NIWA-UKCA and ACCESS-CCM data to a 126-level pressure grid, for easier comparison.

- line 341: "reductions of sea ice cover": Please be explicit here or in the presentation of the models which models do not use a prescribed sea ice albedo.

  We now include a comment on coupling. This does not have a direct effect on the sea-ice albedo because both coupled and uncoupled models would take into account the albedo of shrinking sea ice.

My minor or technical comments are the following:

- line 25: "first phase of CCMI": add "(CCMI-1)"

  Done.

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- line 57: "lower and middle atmosphere": Please indicate a range of pressures.

  Done.

- line 62: Correct "to due" with "due to".

  Done.

- line 97: Please specify the scenario.

  Done.

- line 112: "final section": Please speficy the section number.

  Done.

- line 184: "multiple simulations"

  Done.

- line 278: Please explain the "EESC" acronym.

  "EESC" was used in error. We have replaced this with "Cl^{eq}".

- legend figure 7 and figure 8: Replace Cl_y by Cl^{eq}.

  Done.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2017-565, 2017.

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