Atmos. Chem. Phys. Discuss., 15, C10079–C10083, 2015
www.atmos-chem-phys-discuss.net/15/C10079/2015/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Drivers of changes in stratospheric and tropospheric ozone between year 2000 and 2100" *by* A. Banerjee et al.

Anonymous Referee #2

Received and published: 3 December 2015

The authors explore the roles of future climate change, changes in ozone-depleting substances (ODSs), and reductions in non-methane ozone precursor emissions in both stratospheric and tropospheric ozone changes, using a global chemistry-climate model comprising both stratospheric and tropospheric chemistry. They also carry out an analysis on associated changes in ozone chemical budget terms. The paper is well written and the analysis is quite thorough. The paper is within the scope of ACP. It should be accepted after the authors have addressed the following comments.

Specific comments:

Why do you choose not to include methane changes in the RCP8.5 scenario simulation? It would be an interesting perspective to see how much impact such a significant increase of methane would have on both stratospheric and tropospheric ozone. Maybe

you could elaborate on this in your introduction.

P30648 line 3: You should state that the purpose of using Ox is to account for the chemical cycling of the species in this family of Ox, and O3 is the most abundant member of this family. The Ox family should also be defined here. Do you also express ozone dry deposition in the format of Ox? How much is O3 deposition if that's the case (in Table 2)?

P3069 line 7: should note that methane does not follow either scenario, and is fixed.

P30649 lines 7-11: should remove "However. . .on these topics" and the previous sentence needs to be followed by citations.

P30652 lines 4-5: should give definition of the tropopause used here.

P30652 line12: Does it make sense to assess temperature changes (especially the lower atmosphere) in an atmosphere-only model? Please comment.

P30652 line 17-20: These statements are rather vague. Can you describe what specifically will be discussed in the following subsections?

P30654 line 9-10: Please note that same prescribed SSTs are used in these perturbation runs as in the Base run so the model cannot realistically capture temperature changes in response to changes in ODS and precursor emissions, especially in the lower atmosphere.

P30654 lines 25-26: How much is this as a percentage increase?

P30655 lines 8-10: More precisely, changes in ozone precursors have limited impact on stratospheric ozone here.

P30655 lines 18-21: The finding here seems based on Fig 3 so should be placed after the next sentence.

P30656 lines 1 and 2: "change" – should say it is positive or negative. Same with the

following “change”.

P30656 lines 23-24: Could you give references here, i.e. “from theory and previous model studies (references)”?

P30656 lines 24-25: Could you elaborate on the role of methane changes even though you keep methane fixed in perturbation runs.

P30656 lines 25-26: “However. . . impacts on the troposphere” sounds like a conclusion – you normally do not conclude before the analysis.

P30657 line 9: should give references regarding “multi-model means”

P30657 lines 25-27: I cannot see the synergy between “The balance between the terms” and “the Base ozone burden is close to the ACCENT and ACCMIP ensemble means . . .”. Can you clarify? Also need to clarify in this section that if Ox dry deposition includes those non-ozone species, and how much is actual O3 deposition in the mix if that’s the case.

P30658 lines 22-23: “Figure 4a shows that consideration of NCP alone, . . ., would suggest reductions in ozone burden” – I don’t think there is a strict linear relationship between NCP and ozone burden. Ozone burden is determined by the loss rate and its lifetime.

P30659 lines 6-7: Sensitivity is usually expressed quantitatively. The sentence is also vague. How about replace "sensitivity" with "response"?

P30659 lines 7-17: What do these tell us? What is the useful message? Regarding the statement "the sign of the change in the ozone burden is not agreed upon by models", do you mean different models in one experimental setup or in different experimental setup? The cited model or multi-model studies have different emission and climate scenarios so it should not be directly compared.

P30659 lines 22-24: A bit of jump here; could you give some context as to why methane

adjustments are discussed? Why not move this prelude to the next section?

P30661 lines 2-3: Quantifying the individual importance of these processes is not beyond the scope of this study I would say; you could analyse the chemical budget. In the lack of relevant diagnostics, you should note that, e.g., "We do not individually quantify these processes ..."

P30665 lines 29 – 2 next page: It is not surprising that with the reduction of ODS, tropospheric ozone has a substantial increase through STE, which offset chemical loss of ozone through increased water vapour.

P30668 lines 17-19: I think you’d better say “although we cannot verify such assumption here due to lacking relevant diagnostics in this study. . .” rather than saying “it is beyond the scope of this study”.

P30669 line 10: Could replace “stratosphere” with “changes in stratosphere”?

P30670 lines 2-3: “; the upper troposphere is a key region for ozone as a radiative forcing agent.” - This is not the finding from this study, you might want to say "this should have implications for the climate feedback as UT is a key region for ozone as a radiative forcing agent".

P30670 line 23: add “and uncertainties” after “differences”

P30689 Figure 8: Why don’t you use the same colour scale for a) and b), and e) and f)?

Technical corrections:

P30648 Line 21: missing “et al.” in Collins and Sudo citations.

P30651 line 20: missing “et al.” in citation.

P30661 line 16: “MeO2” should be denoted as “CH3O2”

P30662 line 8: see above regarding “MeO2”

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 30645, 2015.