

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2021-35

Anonymous Referee #1

Referee comment on "Atmosphere–ocean–aerosol–chemistry–climate model SOCOLv4.0: description and evaluation" by Timofei Sukhodolov et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-35-RC1>, 2021

Sukhodolov et al. (2021) describes the configuration and some evaluation of the SOCOLv4 composition-climate model. It is generally very well written and presented, and I recommend its publication in GMD following some minor revisions. I have no major issues or comments to make on the manuscript.

The minor comments that I have are:

- Page 3, lines 96-98: This is very minor - you introduce the component models and their acronyms here, but the references aren't given until Section 2. Objectively, this is fine as everything is referenced, but as a new reader I noticed that no references were given.
- Figure 1: The colours used for the blue and turquoise boxes are quite similar, could you have a greater colour contrast?
- Figure 1: Tropospheric aerosols are listed as a boundary condition for both ECHAM6 & MEZON, and I was wondering how these were different from the aerosols calculated from AER? Are these BCs purely the SADs for N2O5 hydrolysis?
- On page 5, lines 133-134 you state "Hereafter we refer to MPI-ESM1.2 as MPI-ESM", but then on page 11, line 296 you say "SOCOLv4 is based on the latest version of MPI-ESM (v1.2.01p6)". I'd suggest removing the version number here and putting it in the earlier section.
- Figure 3b: given SOCOLv4 uses an interactive ocean, is a time-series comparison of Nino3.4 index the best method of comparing these quantities? Perhaps histograms similar to Figure 1 from Nowack et al. 2017 (<https://doi.org/10.1002/2016GL072418>) would be a better way to present these data?
- Page 14, line 381: "The left panel of Fig. 4" - I would suggest ensuring that all figures have each sub-figure labelled (e.g. a, b, c etc.) and specific sub-plots or a range of sub-plots are referred to using these, e.g. "Figures 4a - 4c..." etc. Some figures don't label their sub-plots (7, 8, 9, 12, A2), whereas other figures do (3, 4, 5, 6, 10, 11, 13, 14, 15, 16, 17, A1, A3). I would advise labelling all for consistency and clarity, and avoid using references similar to "the first plot in the left column" etc.
- Figures 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, A1, A2, & A3 do not have a colour-bar

despite having coloured contours. While the black contours are labelled, I suggest also including the colourbar on these plots.

- Page 24, line 523 - what is being overestimated at the entry point? Is it the water vapour concentration itself, or something else?
- Page 27, line 586: "CLONO₂" rather than ClONO₂
- In Figure 13 I would be interested in seeing difference plots of total ozone, especially due to the stated reduction in TOC in SOCOLv4 coming from the corrected photolysis rates (page 31, lines 675-676).
- The image quality of Figure 14 seems lower than the other figures, is it a lower quality raster image?
- This is just a comment, but I found the differences in TOC coming from the aerosol climatology used for CCM1 used and seen in Figure 15 very interesting.
- Figure A2 caption: "ClONO₂" rather than ClONO₂.
- Page 43, line 879: there is a gap in the DOI for the SOCOLv4 source code link
- I would advise (although I'm sure you will do this in any case) to double-check references to pre-prints and discussion papers. For instance the Keeble et al. (2020) reference is now published, which occurred after the discussion started for this paper.