

Interactive comment on “Historical greenhouse gas concentrations” by Malte Meinshausen et al.

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Received and published: 29 November 2016

Comment 1: The paper by Meinshausen and colleagues presents historical climate model scenarios of GHGs. There are numerous extensions over their CMIP5 efforts that together make considerable progress on a number of fronts. Particularly impressive is its knitting together of observations and models. This will also help the two communities understand the others needs. The paper represents a huge amount of work by the author team and it provides huge community good. I was very impressed.

Reply 1: Thanks.

Comment 2: The paper is long, has complex figures and contains a lot of technical detail. I would argue that this is appropriate and necessary for the GMD approach to allow clarity of methods and their reproducibility. The paper goes beyond simply documenting the method and showing the data. It details comparison to other data,

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and has a very interesting discussion and limitations sections that has insights into ESM uncertainty and possible effects on climate.

Reply 2: Thanks. We appreciate the understanding for the lengthy paper format.

My suggestions of corrections are of only a technical nature, outlined below

Comment 3: Ln 26-27. I would argue that lots of things change climate not just GHGs and aerosol. I would maybe phrase as GHGs largely responsible for the warming and associated climate change?

Reply 3: Suggestion taken on board.

New text reads: “Those elevated GHG concentrations warm the planet and - together with net cooling effects by aerosols - are largely responsible for the observed warming over the past 150 years.”

Comment 4: line 28 and 40. The future climate change comments seemed strange in abstract as to me the future is another but related problem - the paper really helps sort the past, but your call

Reply 4: Thanks. We deleted “future” climate change in line 28/29. At the end of the abstract, we keep the outlook for why the modelling of past climate change can be important for the future (i.e. reduce uncertainty).

Comment 5: Abstract. Time period is not mentioned - only 1850 date. Also not at all clear you are talking about historical scenarios - or changes through time. 0-2014 ins mentioned but analysts concentrates on 1850-2014? Will historical runs end at the end of 2014? I thought it was 2015, but I may well be wrong!

Reply 5: We clarified the abstract. And no, the data only runs until the end of 2014 – a convention across multiple historical CMIP6 datasets. We also clarified that the astronomical year 0 (the year before 1 AD) equals the Gregorian or Julian year 1BC.

New text: “The focus rests on the period 1850 to 2014 for historical CMIP6 runs, while

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the data is provided from the beginning of year 0 (year 1 BC) towards the end of 2014”

Comment 6: Maybe I’m stupid but it did not seem clear where the data could be accessed?

Reply 6: There is a dedicated “Data Availability” section at the very end of the GMD manuscript before the references. We now included the main links also in the abstract.

New text: “The data is available at <https://pcmdi.llnl.gov/search/input4mips/> and www.climatecollege.unimelb.edu.au/cmip6”

Comment 7: The paper would benefit from a careful proof read. I am afraid that it is beyond my community spirit to do this! But examples are 1. Sections are not referred to consistently, sometimes by names, sometimes by numbers sometimes both cf In 70,128,210 (e.g.) 2. There are typos in places e.g.1026-1027 (to prove i read to end!) 3. The odd statement is repeated 4. Equations are not presented as uniformly as they might be e.g. 230-236 e.g. $n \times m$ 5. Do you want asterisks or for multiply or something else? line 210 Figures 20 and 21 might also be useful here -these don’t seem to be referred to in text?

Reply 7: Our apologies. We now performed another proof read by “fresh eyes”. Thanks to Zebedee Nicholls in that respect. Specifically:

1. We now refer to section always by the section number, and in some cases, where the title assists the reader also by the title, i.e. when referring to the “Limitations” section.
2. 3. Thanks. We had a native speaker proofreading the manuscript again.
4. 5. We made the deleted duplications, where we found them.
6. 7. We corrected $n \times m$ to ‘ $n \times m$ ’, i.e. using the standard multiplier sign, and streamlined other equations to some degree, e.g. by deleting superfluous multiplier asterisks “*” or replacing it by the ‘x’ sign where useful for readability.
8. 9. Thanks for spotting that Figure 20 and 21 were not referenced in the text. That was due to a non-dynamic Figure link, as the figure references in the following paragraph meant to point to exact those figures. Now

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corrected. 10.

Comment 8: Figures don’t seem to appear in the correct order - I’m not sure what your logic is here?

Reply 8: Thanks. The figures have now been sorted. Figures 1 to 22 in the main manuscript should be ordered in the order of appearance of their reference. Appendix A contains the factsheets of other gases. And Appendix B contains to supplementary figures that are related to Figure 16.

Comment 9: line 167 - that are these AGAGE? files - maybe giving a web address early on where files could be found would help? Or adding more explanation?

Reply 9: Suggestion implemented. The website for the data is now provided, i.e. http://agage.eas.gatech.edu/data_archive/agage/.

Comment 10: 189-193 - it is not clear which scalings are being referred to for what gases?

Reply 10: We rephrased lines 189-193 to hopefully make it clearer what happens to CO₂ (nothing), CH₄ (Tohuko is converted to NOAA04, if necessary) and N₂O (nothing), so that those lines read:

“In the case of CO₂, we source all our CO₂ station data from the NOAA network, which means no scale conversion is necessary. In the case of CH₄, we account for different calibration scales by converting AGAGE CH₄ data (Tohuko University scale) to the NOAA scale (NOAA04) (multiplication by 1.0003). In the case of N₂O, both the AGAGE (SIO1998) and NOAA network calibration scales (NOAA-2006) are compatible without the need for a conversion factor (WMO, 2012).”

Comment 11: I found Table 1 really useful in helping me understand your methods - could this be referred to earlier?

Reply 11: That was our oversight. We now inserted the reference to Table 1 early on

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in section 2.1, by stating "...Figure 1 and tabulated also for the three main GHGs in Table 1."

Comment 12: The figures are generally good considering their complexity - but details are hard to see even when zooming in online, such as the small "5" on fig 22 referred to in the text.

Reply 12: We acknowledge the complexity and dense information content of the figures. We hope that the final manuscript, with a vector rendering of all the figures (rather than the medium raster resolution that is present in the discussion paper) will make small details much more readable, especially when using zoom.

Comment 13: I also found it hard to see the CMIP5 lines on the CMIP6/CMIP5 comparison figures.

Reply 13: Thanks. We changed the thin CMIP5 lines towards thicker red lines.

Comment 14: On the science I had a few questions 1. It might be useful to quote 1750 PI concentrations and 2011 concentrations to compare to IPCC. A comparison might also be fun with IPCC historical forcings?

Reply 14: We do provide 1750 and 2011 concentrations in Table 6 for the main gases. Furthermore, we compare our 2011 concentrations to the various 'networks' estimates as stated in IPCC AR5 WG1 in our Table 7.

We hesitate to compare our linearized illustrative forcings to IPCC – at least for CO₂, CH₄ and N₂O (Figure 6 upper panels), as our forcings are only using linear radiative efficiencies, not even simple saturation formula. However, we will introduce comparison IPCC AR5 numbers for year 2011 in the middle and lower panels of Figure 6 for comparison.

Comment 15: 2. I guess your forcing estimates were all made with global radiative efficiency formula - are you going to run your fields through a radiation call to estimate actual forcings. Give me a shout if you would like someone to do this!

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Reply 15: Thank you very much for your kind offer. We will take you up on that for a future project.

Interactive comment on Geosci. Model Dev. Discuss., doi:10.5194/gmd-2016-169, 2016.