

We would like to thank the reviewer for his/her comments and very supportive words. We are showing below the original review comments in italics and our response in plain text, indicating our plan for the revised version.

*Revisions are needed for language and clarity. In some places it looks as though an entirely different co-author took over.*

This was indeed the case and we will make sure that the language is of a more uniform voice in the next version.

*2447/5 The order is wrong, this paper documents the composition changes first (that is what ACCMIP calculates as a primary variable) and then the associated RF./10 'lead to' is odd, you mean 'have', drop the second 'in emissions' as redundant, but replace with 'across models':*

OK. We'll make the suggested changes.

*" natural emissions have a significant range across models, mostly. . ." /15-16 This is totally obtuse, I am not sure what is meant here, or if it is 'abstract' material.*

We believe it is abstract material because it is a clear source of model spread. The sentence will be rewritten to make the message clearer.

*2448/1 Does ACCMIP have that many more models (than 8)? From a look at those for example reporting the hourly data, it was only about 8 out of 15.*

Yes, we have indeed 16 models. Not all of them have submitted hourly data however.

*2449/5 "ACCMIP takes advantage. . ." verb tense /14*

We'll make the suggested change.

*A paper cannot be a repository since it is static, it can be a first point of reference, or the primary documentation defining the simulations and an overview of the inputs and outputs.*

While we agree with the suggestions, we disagree with the fact that it cannot be a repository. Based on available definitions (such as Merriam-Webster "one that contains or stores something nonmaterial <considered the book a repository of knowledge>"), we'll keep repository.

*/29 'physical climate variables'*

Yes. We'll make this change.

*2450/1 'climate change in response to 21st century forcing' ? is that what is meant*

Yes, that is the intended meaning. We'll clarify.

*/4 'decadal' is vague and jargon, it could mean every decade the model does a one- week slice. Why not say 'decade-long time slices for specific periods from 19xx to 2100?'*

*Sorry for this use of jargon. We will make the suggested change.*

*/8 The use of letters 'C' and numbers '1' is odd and should be made more consistent if possible after the fact. Note that the additional simulations were designated Tier 2 (not discussed here). It might be better to designate all of these "tiers" as "optional" which makes more sense after reading the discussion below.*

This was for included for historical reasons but the suggested changes will indeed make this table clearer.

*/11 I would use "prescribed short-live . . . and long-lived concentrations. . ." Were these prescribed? Make this clear that these were the driving factors (Were they complete? What was not specified? Did everyone use these forcing conditions?)*

Yes everyone used the same prescribed long-lived concentrations. We will modify the text accordingly (also to include suggestions by M. Schultz).

*2451/2 'but with an 1850 . . . climate as specified by sea surface temperatures(?)' – give a simple explanation of how the other climates were imposed.*

This was done through specification of long-lived concentrations and sea-surface temperatures. This will be clarified.

*/5-10 Can you comment on how the multi-year average SSTs reduced the inherent variability in circulation and chemistry?*

This is beyond the scope of this paper. But, on the diagnostics that we focused on (mostly global averages), the little bit of analysis we performed on NCAR-CAM3.5 results show very little impact.

*/? What did the models do about solar cycle and volcanoes in the future? CMIP5 chose some very odd formulae.*

Impact of solar cycle is quite small on tropospheric chemistry so nothing was specified in the ACCMIP protocol (this will be made clear). No volcanoes in the 21<sup>st</sup> century, as in CMIP5.

*2455/11 Comment: Even with convective mass flux diagnosed/fixed, most models implement this in such different ways that the effective tracer transports are not equivalent.*

This is a good point. Text will be added.

*/20 What is not important is whether the entrain/detrainment is specified (air mass) but that it is used to remove soluble/sticky species – please clarify this sentence.*

We will clarify to mention that the entrainment is not just of mass but of chemical constituents as well.

*2456/22 ‘to reach a preset VALUE (by each . . .’ ??*

Indeed VALUE is missing. This will be fixed.

*/25 ‘erroneously’ is an odd word here, did the MIROC modelers make a mistake or just pick a higher value? “anomalously” describe the range relative to the rest of the models – is that what is meant? I am not sure we really know what is in ‘error’ here.*

There was indeed an error in that both models ending up with values that were not what they intended. So we’ll keep the term “erroneous”, as it was agreed by the co-authors.

*2458/1-15 Is it worth pointing to CCMVal’s Photocomp as providing a bit more information on the different photolysis schemes ? making this section more parallel with the convection discussion that seems more instructive and useful.*

We will include such reference (also requested by M. Schultz). We will try to expand it slightly, but specific of the impact of differences are discussed in more details in other ACCMIP papers (such text will be included).

*2462/9 Typo: “6 unitK”*

Sorry. Typo will be fixed.

*/12-18 Any comments on how this would affect the chemistry? Specific humidity controls the O(1D)+H<sub>2</sub>O pathway, and relative, the aerosol size and OD.*

We will include a discussion of this, using information from impact of climate change studies (as summarized in Jacob and Winner for example).

*/18-29 Some confusion about sub-tropical jet vs. polar jet. Clearly the former is vital as it determines the extent of the tropics and trop OH, but the latter may have less impact except in the stratosphere. Can you separate the discussion of the different jets more clearly and maybe motivate why ACCMIP cares?*

Good points. We’ll be more careful in discussing zonal-mean wind.

*2463/ff It may be beyond the scope here, but it might be useful to document change from 1960-2000 or 1980-2000 as some of the 2000-climate differences appear to be due to changes in that recent epoch, rather than an overall pre-industrial to present.*

This is indeed beyond the scope of this overview paper. 1960 was not a requested simulation so we don’t quite have data for that. There are simulations available for 1980

but the significant changes are more at the regional scale than what is being discussed in this overview paper.