

**Response to Interactive comment on by F. Brient on “The Cloud Feedback Model Intercomparison Project (CFMIP) contribution to CMIP6” by Mark J. Webb et al.**

Reviewer comments below are shown in bold and our responses are in italics.

*Dear Florent,*

**This paper summarizes the objectives of CFMIP and the contribution of CFMIP-3 to CMIP6. CFMIP helps to explain the spread of cloud feedbacks, adjustments and processes across climate models. This updated contribution goes a step forward and suggests additional experiments to allow the community to tackle in more detail the physical reasons underlying dynamical and regional biases seen in climate models. By proposing experiments that test especially the atmospheric components of climate models, CFMIP provides a relevant framework to understand and improve cloud parameterizations and processes which remain the principal sources of surface and atmospheric model biases.**

**First, the authors summarised well how former CFMIP/CMIP5 experiments helped to improve our scientific understanding of climate feedbacks. It thus provides a relevant background supporting the additional experiments that they advise the modelling groups to perform. I particularly appreciated (1) the will to promote the analysis of experiments when cloud radiative effects are switched off, (2) the pertinent time slice experiments aiming to understand regional climate responses and (3) the encouragement of a more extensive distribution and use of physical tendencies which are a signature of the atmospheric components of climate models.**

*Thank you for your careful consideration of our manuscript and for these helpful comments.*

**Below, I have listed a number of minor points which might be addressed to clarify the text (if the authors find them useful)**

**- Some acronyms are not defined : AOGCM (l.83), GCM (l.92), RFMIP (l.378), TOA (l.637), PMC (l.777)**

*We will define these in the revised manuscript.*

**L. 196 : I have trouble understanding the meaning of “known answer”.**

*We will modify this sentence to read:*

*“Aqua-planet simulations (and other idealized) experiments are particularly effective at highlighting model differences, for instance in the placement of the tropical rain bands, or in the representation of cloud changes with warming, as it is not possible to tune them to observations in the same way as is for more realistic configurations (e.g., Stevens and Bony, 2013).”*

**L. 217: The amip-future4K experiments used the CMIP3 pattern of SST increase. Is this pattern consistent with the one derived from CMIP5 models?**

*We haven't looked into this, because we consider consistency with the CMIP5 protocol to be more important than using SSTs from CMIP5 rather than CMIP3.*

*We will add the following to Appendix C:*

*"We have retained the SST forcing based on the CMIP3 coupled models because we consider it more important to be able to compare CMIP5 and CMIP6 models forced with the same SST pattern than to use a pattern which is consistent with, say, the CMIP5 coupled response."*

**L. 222-225 and L. 419-422: I'm a little bit confused about all 4xCO2 experiments. The amip4xCO2 experiment involves the CO2 effect on the atmospheric component and land warming without the vegetation feedback. It is thus "equivalent" to the piSST-4xCO2-rad experiment listed in section 2.7 (but not to piSST-4xCO2). I guess abrupt4xCO2 takes into account the vegetation feedback. So, the amip4xCO2 experiment should be named amip4xCO2-rad, doesn't it?**

*We agree that this would be a more consistent naming of this experiment. However, we think that the experiment descriptions are clear. Unfortunately however we understand that CMIP6 experiment names have now been finalised and propagated to the ESG and so it is not now possible to change them.*

**L.257-264: You could also add the reference "Block and Mauristen (13) JAMES - Forcing and Feedback in the MPI-ESM-LR coupled model under abruptly quadrupled CO2", which highlights the utility of diverse amip-pXk and abrupt2xCO2 experiments.**

**L. 288-299:**

*We will add a citation to this paper in section 2.5.*

**(1) It is thus right that LW effects are the most important contributor to cloud atmospheric radiative effects, and SW effects play a minor role (e.g. Takahashi 09). Nevertheless, local SW cloud effects exist (Pendergrass and Hartmann, 14). It might thus be interesting to point this fact out in the text and leave the discussion about SW effects sufficiently open.**

*We will add the following to section 2.3:*

*"We note that the presence of clouds does affect the shortwave radiative heating of the atmosphere, although this is a much smaller effect than its longwave equivalent (e.g. Pendergrass and Hartmann, 2014)."*

**(2) Since only LW radiative effects are removed, does it mean that models still have a SW cloud feedback but no LW cloud feedback?**

Yes. We will clarify this by adding the following to section 2.3:

*“In this configuration, the models will have a shortwave cloud feedback but no longwave cloud feedback.”*

**(3) “and the radiation code only”. Does this mean that, for instance, a boundary-layer parameterization based on LW cloud-top radiative cooling continues to see LW effects?**

We will add the following comment to section 2.3:

*“Care should also be taken to remove the effects of cloud on any longwave cooling used in other model schemes (e.g. turbulent mixing) if these are calculated independently of the radiation scheme.”*

**L.326-328: Contrary to CO2 effects, the radiative forcing of solar insolation depends on latitude. Is this dependency taken into account when the authors state that a 4% change results in a “radiative forcing of a similar magnitude to that due to CO2 quadrupling”?**

*Yes this has been taken into account. We will modify the text as follows to make it clear that this gives a similar magnitude in global mean forcing.*

*“...resulting in a global mean radiative forcing of a similar magnitude to that due to CO<sub>2</sub> quadrupling.”*

**L. 482: Single Column Model already defined line 91-92.**

*Duplication removed.*

**L. 600-601: Is it normal that “cfDay-2d” is named by CMIP5 and not CFMIP? Why is there no CMIP5 or CFMIP prefix for “cfDay-3d”?**

*The different prefixes represent detail in the formal data request which is not required here. In the manuscript we will delete the prefixes to avoid confusion, and will add the following sentence:*

*“(Please note that in the full data request these variable groups are in many cases split into a number of sub-tables. As noted above, the formal data request provides the definitive specification of the model outputs.)”*

**Fig.1 : The DECK is written in the caption but not highlighted in the graph.**

*We will update the figure and caption to be consistent in this regard.*

**Fig.1: I consider lwoff experiments as part of the “Clouds” analysis. You may consider**

**making the arrow longer.**

*We will do this.*