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Interactive comment on "Overview of the Coupled Model Intercomparison Project Phase 6 (CMIP6) experimental design and organisation" *by* V. Eyring et al.

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Reply to Gareth Jones

Thanks Gareth for the helpful comments. We have now revised our manuscript in light of these and the other comments we have received. A pointwise reply is given below.

The paper is a clear and concise description of the CMIP6 design. It is extremely useful to modelling centres to have such a document to describe the

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experimental set up of the DECK and historical simulations expected for CMIP6.

Below are some comments that I hope the authors will consider and find helpful.

Section 3 Why the historical (1850 to present) simulation is not part of the DECK is not explained. It has been a curious discrepancy that I have not seen an adequate explanation for. Given the AMIP experiment is supposed to have the same radiative forcing factors as the historical experiment it would seem obvious to include the historical simulation within DECK too. Apart from simplifying the design, it would make it less cumbersome in talks/reports/papers/documentation for modellers and users to just call it 'DECK'.

The text has been expanded (2nd paragraph in Section 3) to better explain this, see also our response to a similar comment by Referee #2.

Page 10546, Lines 21-25 For the cases of models in CO2 emission mode, won't there also be a requirement for there to be a piControl that is in CO2 concentration mode, to enable analysis of the amip, 1ptco2 and abrupt4xco2 experiments?

This is already implicit in the CMIP design which asks for the DECK being performed for all model configurations (see page 10546).

Page 10547 Line 27 to Page 10548 Line 1 The consistency of experiments over time will not strictly hold for amip. The forcing factors, and to a lesser extent the SSTs, will change from CMIPx to CMIPy. It would be helpful to clarify this.

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This is true and is strictly speaking also true for the *piControl*. But our leading argument what to include in the DECK is that these simulations are routinely done and possibly repeated many times over a long period of model development by the groups with whatever forcings are available. We still want the AMIP simulation that is then submitted for a specific phase to use the exact forcings of that phase to be compliant with the historical simulation, see also our response to the above comment.

Page 10549 Line 13 It would be really helpful to have a minimum length for the *piControl*. Elsewhere it is recommended to have the same length as whatever experiments are spun off, but that could mean for a model just providing the DECK (and historical experiment) the piControl may be only a 160 years long.

We agree and have deleted the sentence 'The length of this 'spin-up' period is model and resource dependent." since a minimum length is specified in the Appendix.

Page 10550, Lines 9-13 It would be a worrying precedent to promote the use of the historical simulations as a tool to constrain the uncertainties in the forcing factors that are then put in the models. As historical simulations are used in model validation (Page 10566 Lines 12-14) such a policy will introduce circular reasoning [Rodhe, 2000]. Such circular reasoning will reduce the usefulness of the models in understanding past climate changes and also reduce confidence in projections.

The sentence on page 10566 has been reworded.

Additionally the authors are being over enthusiastic when they say that historical simulations have "proven essential in reducing uncertainty in radiative forcing associated with short lived species such as the atmospheric aerosol" Apart from the inherent circular reasoning, many aerosol climate

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scientists may strongly dispute how 'essential' this is.

Sentence removed.

Page 10563 Lines 12-14 It will be obvious to many, but not all, that the implementation of a background volcanic aerosol in piControl has implications for historical and historical natural experiments. During periods of no volcanic activity the radiative forcing from volcanoes, with respect to the control, will be positive. This has been surprising to some in the past, so it might be useful to highlight this.

We have revised our discussion of volcanic forcing following the bulleted summary of forcing specifications. A paragraph is included explaining the rationale for imposing a background aerosol in the *piControl*.

Page 10563 Lines 21-26 "Modelling groups are urged to perform this experiment ... as doing so will most effectively separate the role of natural vs. anthropogenic drivers of climate change and variability since 1850." If it is so important it obviously makes sense to make the natural experiment part of the DECKplus (DECK + historical) suite. Asking modellers to do one experiment for a MIP (in this case DAMIP) but not the other experiments within a MIP is confusing.

We do not think that encouraging modelling groups to run a specific CMIP6-Endorsed MIP experiment in this paper justifies inclusion of this experiment in the DECK. We simply encourage modelling groups to perform this experiment because then they will be able to determine whether in their model the specification of control-run volcanic forcing leads to an artefact in sea level changes during the historical period. We have modified the text somewhat to explain this better.

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Additionally has there been any consideration to the usefulness of doing just one natural simulation? The signal to noise is usually very low for many climate diagnostics from a simulation driven with natural forcings. One ensemble member will not be helpful for the interpretation of the results of a single model. However, it may be useful as part of a multi-model analysis.

These questions will be addressed by DAMIP.

Page 10564 Lines 6-7 This is an important point. More guidance about what to do would be helpful here. For instance HadGEM2-ES gradually ramped up the aerosol in the stratosphere for the RCPs [Fig 14 in Jones 2011], but the way this was done may not be the best way. If all the models reintroduce the volcanic aerosols in the scenarios in a similar way, it could introduce a signal to a multi-model mean which may be misinterpreted. Given relatively small volcanic eruptions possible role in reducing short temperature trends, how future background aerosols are re-introduced should be discussed.

Since we are not discussing the forcings beyond the DECK and the CMIP6 historical simulation here, we refer to the ScenarioMIP contribution and the volcanic aerosol forcing paper in this Special Issue, where the treatment of volcanic aerosol in the future scenarios will be specified. But we have clarified, also in response to the comment by Alistair, that a non-zero value will be used.

Page 10566 Lines 12-14 The definition here is a little worrying. "The CMIP6 historical simulation is meant to reproduce observed climate and climate change". That implies the simulations have to be tuned to match the observations. Rather the historical simulations are designed to be compared with observations for various hypothesis testing

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Agreed and sentence changed.

Page 10567 Lines 10-18 It is useful that a "historical-extension" is recommended, but it would seem logical to include it as part of DECKplus. Where would it be allocated to if not? Documentation about what was forcing the extension runs - which was largely missing from CMIP5 - will be crucial, but an agreed scenario for the historical-extension would be even more helpful.

The idea is that the extension would be based on observations, not a scenario. It is impractical with current resources to promise that a standard post 2014 observational dataset will be made available, so we'll have to live with documented non-standard datasets. This extension is considered included in the DECK, but the details on how it will be handled by the infrastructure are still under discussion, so we can only indicate at this time that the runs will be named *historical-ext* or *esm-hist-ext* (for the emissions-driven run).

Page 10568 Lines 9-11 It seems curious that a requirement from DAMIP is singled out here (see also Table 2). If extra ensemble members are really so strongly required outside of DAMIP, it would seem logical to include them in the DECKplus.

We do not think that encouraging modelling groups to run a specific CMIP6-Endorsed MIP experiment in this paper justifies inclusion of this experiment in the DECK. We simply encourage modelling groups to perform additional ensemble members and not pointing to DAMIP that has the additional ensemble members in their Tier 1 would unnecessarily remove existing information. A model group could still run ensemble members and submit them to the ESGF even if it doesn't participate in DAMIP.

A final comment. A central reference point, with DOI, that lists all the models

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and subsequent links to their documentations would be a great addition to CMIP6. The increasing demands on authors and the increasing size of CMIP6 would be countered somewhat by not having the requirement to reference every model in every paper.

The WIP is considering different formats and different granularities to provide DOI's, which are still under discussion, so we are unable to say anything more specific at this time.

References

Jones, C.D. et al., The HadGEM2-ES implementation of CMIP5 centennial simulations, Geosci. Model Dev., 4,543-570, 2011 Rodhe, H.; Charlson, R.J. and Anderson, T.L., Avoiding circular logic in climate modeling, Climatic Change, 44, 419-422, 2000.

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