

Interactive comment on “AerChemMIP: Quantifying the effects of chemistry and aerosols in CMIP6” by William J. Collins et al.

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We wish to thank Alex Archibald for taking the time to make valuable comments on the AerChemMIP description.

Collins et al. present a nice summary of the rationale and design of the Aerosol Chemistry Model Intercomparison Project (AerChemMIP), a CMIP6 endorsed project that is designed to quantify the climate and air quality impacts of aerosols and chemically reactive gases in the atmosphere. AerChemMIP is a huge project and reading through the number of simulations in the tables it's clear that a huge amount of thought has gone into this and by and large I feel that the requests are reasonable for answering the overarching science questions stated. However, one of the primary reasons for undertaking these experiments (and previous experiments like ACCMIP, CCMI etc) is

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to understand the functioning of coupled chemistry-climate models in a multi model framework. The climate community are in a great position with the DECK experiments in that they can use these to understand how as a function of time the evolution of models leads to improvements/changes in our understanding of the physical climate system. But what parallel is there for the aerosol and chemistry community? What is our DECK experiment(s)? I think a short discussion on this would make a useful addition to this paper.

The science goal of AerChemMIP is to quantify the contributions of reactive gases and aerosols to the climate in the CMIP6 simulations. Since the climate modelling centres will be contributing to a wide range of CMIP6 MIPs we deliberately limited the number of experiments and focussed these on the above science goals. Process-oriented evaluation of chemistry-climate models on the other hand is covered by the more specialised aerosol and chemistry projects AeroCom and CCMI, which will feed information into AerChemMIP with respect to model performance and how it may affect results. We agree that the aerosol and chemistry modelling communities would benefit from the design of at least some additional idealised experiments to characterise model performance from one generation to another, and suggest that AeroCom and CCMI remain the appropriate projects to pursue this. As a minimum step in this direction, we note that the AerChemMIP timeslice ERF experiments (piClim-...) will allow us to explore the model responses to step changes in emissions of individual species or groups of species. We will add text to clarify this additional value of the ERF experiments.

Also, I noted the following minor errors in the manuscript:

Page 3 line 10: "contribute" should be "contributes". Page 3 line 38: after "chemistry-climate models" could you add "(CCMs)"?

Page 3 line 38: similarly, after "chemistry transport models" could you add "(CTMs)"?

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Page 4 line 3: Why is "Chemistry-Transport Models" (a) capitalised? (b) hyphenated?

Page 4 line 7: adoptions above mean you could remove "(CCMs)".

Page 4 line 21: The reference list has the "(IPCC 1995)" citation as being published in 1996.

Page 6 line 2: consider replacing "...)" with "etc)"

Page 6 line 25: remove "in" at the end of the line.

We will make all these changes.

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