

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2022-249

Anonymous Referee #1

Referee comment on "The Regional Aerosol Model Intercomparison Project (RAMIP)" by
Laura J. Wilcox et al., Geosci. Model Dev. Discuss.,
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This manuscript describes a model intercomparison project aimed at assess the response of climate models to near-future regional changes in aerosols. Many motivating scientific issues are described and a protocol is introduced. The protocol is based on replacing anthropogenic aerosol and precursor emissions from one scenario with another with lower emissions and performing small (10-member) ensembles of transient coupled simulations. Tier 1 simulations focus on reduced emissions globally and in three select regions; Tier 2 simulations add variants, including further emissions reductions or restricting changes to specific components. The simulations are complemented efforts to characterize the effective radiative forcing with "fixed-SST" time slice experiments at the end of the experimental period (2050). The data requested, including some new diagnostics, is described and the planned analyses are sketched out. Section 4 uses a sample of three models to demonstrate that even the relatively small aerosol perturbations are likely to translate to easily-detectable regional differences in forcing and adjustments. Connections to CMIP6-era MIPs are drawn and possible synergies highlighted.

The following comments are offered in the spirit of helping the authors make the already-fine manuscript somewhat more focused and the protocol more clear and easy to follow.

On communication

It it true that much of the short-term diversity in climate model projections is due to aerosols, including future emissions distributions and how each model responds to them. Nonetheless 120 lines of introduction is more than is required. It would be useful to focus the introduction more tightly on the specific questions addressed by the MIP simulations.

The paragraphs starting on line 200 and 260 motivate but do not describe the protocol.

The paragraphs should be shortened to one or two sentences and/or placed with the rest of the motivating material.

Section 4 demonstrates that changes in aerosol emissions drive different changes in radiation and precipitation across three model even in the absence of surface temperature change. The radiation changes, at least, would normally be considered part of the model-dependent forcing, not the model "response" (line 373 ff). Indeed section 4 might be better title "diversity in forcing and precipitation response" or similar.

On the protocol

It would be useful to be explicit about the time window the simulations in multiple places, including in the table captions.

It would be useful to have a small table detailing the boundaries of the regions so reader don't need to read the captions closely.

Asking participants to create their own emissions files (Section 2.1, Supplemental Information) seems like an unnecessary opportunity for mistakes to be introduced. Could the MIP not create and distribute these files?

The MIP proposers might explain why they have adopted the RFMIP time-slice protocol rather than the protocol for computing transient ERF (3-member, fixed-SST), given the small cost relative to the coupled model experiments and the strong time evolution of the aerosol emissions.

On graphical communication

Figure 1 might replace the two right-most panels in figure 2.

Most figures contain more white space than need. In figure 2 removing repeated axis labels would be a benefit. Figures with 3x3 maps are too small to convey much information, and all the multi-map figures have loads of unnecessary space between the panels.

Figure 5: "Stippling indicates"... is there any stippling? How was this metric for significance

arrived at?

Detailed comments

Line 64: "Aerosol-precipitation interactions" would be more accurate than "aerosol-climate"

Lines 67-70 imply that differences in the global hydrologic sensitivity imply strong regional changes - this deserves a citation if its true.

What connects the many issues raised in the paragraph starting on line 107?

Line 128: "designed to address these challenges..." there are so many challenges listed to this point that it's hard to guess the point of the MIP.

Line 130: a diversity of model results does not represent "uncertainty." Perhaps this could be made more specific and concrete.

Line 138: It is presumably the simulations, rather than the models making them, that will allow the more direct link described here.

Line 176: Perhaps "In common with most CMIP6-related..." CMIP6 encompasses only the historical simulation. Other simulations either come from the CMIP DECK or from satellite MIPs.

Line 181 "copies of jobs" is rather technical - could this explained more generically?

Most of line 224 is superfluous.

Line 280: Does CEDA plan to CMOR-ize everyone's output, or are modeling centers expected to provide CMORized output? How will the CMOR tables be prepared?

Line 290: PDRMIP is mentioned here but not introduced or cited until later.

Line 368: This begins section 4 quite abruptly. A bridging sentence would be welcome.

Line 375: "preempt" -> "address or similar."

Line 375: Perhaps remove "participating" since the experiment hasn't happened yet.