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Comment on acp-2022-766

Anonymous Referee #2

Referee comment on "Opinion: The scientific and community-building roles of the Geoengineering Model Intercomparison Project (GeoMIP) – past, present, and future" by Daniele Vioni et al., Atmos. Chem. Phys. Discuss.,
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Overview:

This manuscript covers GeoMIP past and present. This includes discussion of successful and non-successful experiments and addresses what has been learned from GeoMIP. It finally addresses recommendations on how GeoMIP should progress in the future. It is categorized as an opinion piece. However, it's more of a review than an opinion piece. The title notes scientific and community-building roles of the project, but the paper is really just a review of past GeoMIP experiments, suggestions for future experiments, and doesn't really describe how there has been community building. The paper is also long and a bit disjointed and rambles at times. I'd suggest deleting section 5.1 to shorten things a bit as well.

Comments delineated by section

Section 2 starts off talking about different Tiers. Why are some high priority and others lower priority? Describe for the reader not familiar with MIPs what the difference is between Tier 1, 2 and 3 (or however many there are).

and 2.1-2.8 all sound like they are "past" experiments...you should be clear about what you mean by "present" or delete it from the section title.

Section 2.8 belongs more in a summary than in the middle of the paper.

Section 3 says it is current proposed testbed experiments....are they current or proposed? Some of the text seems to indicate they are proposed, but in other cases it sounds like they experiments have already occurred. How about making the section title just Testbed experiments and GeoMIP adjacent experiments (although I'm not sure what "GeoMIP adjacent" actually means.

Section 4 is titled "Future experiments" But it seems that section 3 was talking about proposed experiments (which seem like they'd be in the future). It seems this section is really talking about potential experiments to look at processes, or maybe it's better to call them Future testbed experiments.

Section 4.7....this should be a different topic (not under Future experiments). And, perhaps, it belongs more as a subset of section 5 or in the Conclusions.

A few more substantive scientific comments:

line 348 says" possibly also highlighting the need for more detailed aerosol microphysics in modal models. " Does it perhaps suggest use of microphysical models that aren't model...perhaps sectional models as well?

paragraph line 534-538: seems like there should be some mention that running a CTM or nudging (or replaying) to a common transport does not allow simulation of any transport changes that are caused by the aerosol heating, or any strat-trop interactions that may occur, so then is not fully simulating surface climate or strat ozone impacts.

Line 574 -576 says " Simulations in MCB can, to some degree, be separated into two categories. First, can clouds be brightened, and if so, by how much and under what conditions? Second, assuming clouds can be brightened, what are the climate effects of brightening clouds in specific areas? " The simulations are not separated into 2 categories, but the questions regarding MCB are separated into 2 categories.

There also needs to be some more thought as to whether GCM comparison runs are really useful for assessing the viability of MCB. They don't resolve the key processes, so it all boils down to parameterizations. I am not sure you can say (as in line 593/594) that any of these simulations will "directly inform deployment decisions". I actually suggest reading <https://www.pnas.org/doi/full/10.1073/pnas.2118379119>

line 530: you may also want to consider this paper (<https://gmd.copernicus.org/articles/13/717/2020/>) in regards to potential issues with specified dynamics runs.

Line 652: says " With the urgency of climate change increasing impacts on societies and ecosystems, there is a great need to continue and accelerate geoengineering research (of Sciences Engineering and Medicine, 2021), and a large merit in its scientific exploration through the use of coordinated multi-model experiments". I would suggest also noting that there is need for model verification using observations, and in particular identifying the key processes that models need to represent for various climate intervention techniques. Therefore, included within GeoMIP could be a coordinated model/measurement intercomparison. You don't just need to highlight outliers, but need to assess accuracy.

Editorial type comments/suggestions/questions:

line 22: This sentence "The comparison of results from nominally identical experiments in multiple, distinct climate models can be a very useful tool for understanding models' biases, robustness in the climate response to external forcings, and for partitioning sources of uncertainties in future climate projections Lehner et al. (2020)."

"comparison of results" is not a tool. Suggest a rewrite to "The comparison of results from nominally identical experiments in multiple, distinct climate models is useful for understanding models' biases, for assessing robustness in the climate response to external forcings, and for partitioning sources of uncertainties in future climate projections (Lehner et al., 2020)."

general editing comment: in many cases the references within the text are not properly formatted. For example, in the sentence noted above, Lehner et al. (2020) should be written as (Lerhner et al., 2020)

Line 32: why do you call these " satellite MIPs"?

Line 29-38 could be deleted. It doesn't add to this paper at all.

Line 44: change "have, so far, been largely insufficient," to "have been insufficient"

line 51: Recognizing what facts? Suggest a rewrite to "Because the goal of 1.5 or 2 degrees warming seems unobtainable, around 10 years ago, an international group of researchers (Kravitz et al., 2011) proposed a new framework to coordinate climate modeling experiments to study proposals for solar geoengineering (also known as Solar Radiation Modification or Climate Intervention), aimed at understanding the impacts of

proposed methods to offset the warming produced by an increase in greenhouse gases by directly intervening in the Earth's radiative balance."

line 55: change "targeting" to "increasing"

line 56/57: delete " (for a comprehensive review of the scientific aspects raised by geoengineering techniques, see for instance"

line 73, since CCT is a common abbreviation, change cirrus thinning to cirrus cloud thinning

line 137: I'd suggest you emphasize simulating in a multi-global model context has proven challenging (since there higher resolution models do a better job on MCB processes).

line 140: You might also mention that one of the reasons that this is difficult (or nigh on impossible) in a global model is that the key microphysical processes can only be parameterized in a global model.

line 261 change " cirrus clouds and rather poorly" to " cirrus clouds are rather poorly"

line 301, use some other term besides "satellite MIP" which is somewhat confusing because that term does not appear on the CMIP web page (nor in any google search). CMIP refers to them as CMIP6-Endorsed MIPs. you could change to "endorsed MIP approach" to match the CMIP terminology.

line 323/324 says " This process could be aided if the World Climate Research Programme (WCRP) took a more active CMIP coordination role." What exactly do you suggest WCRP do?

paragrapn from line 313 to 327: Give some actual suggestions of co-designed experiments. Rather than starting with "We think there are" start with "Possible coordination experiments with other MIPS include..."

line 336/337 says " we also know that using SO2 injection results in large aerosols" How do you know this? Is this a model or measurement result?

line 373 says " support the new phase of CCMI (CCMI-2022) meant to inform upcoming WMO reports. " You might as well say to inform the 2026 WMO/UNEP Scientific Assessments of Ozone Depletion.

610-613 " The scope for impact studies might be expanded in future to e.g. saline intrusion into ecosystems, fisheries, pests and diseases, human health, heat stress and interactions with tropospheric pollutants. " don't say "to e.g." just delete the e. g.

line 887: SPARC is not an activity, it is a WCRP core project, and you might want to also consider collaborations with the ESMO core project (Earth System Modelling and Observations)