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Review 2 of Kravitz et al., ***Comparing different generations of idealized solar geoengineering simulations in the Geoengineering Model Intercomparison Project (GeoMIP)***

Overall Notes

This is my second review of the paper, which compares how two generations of Geoengineering models perform in a 50-year G1 experiment, where CO2 is instantaneously quadrupled and at the same time, insolation is reduced so the net TOA radiative flux is essentially unchanged. Key aspects of the CMIP5 vs. CMIP6 model ensemble results remain unchanged.

The authors have addressed my questions on the Results section in the previous version of the paper and have mitigated some overstatements of the conclusions. However, there remain a few key places in the Abstract, Introduction, and Conclusions sections where I think the way the results are framed still crosses the line. For example, in the Abstract, it states: "*We conclude that despite numerous structural differences and uncertainties in models … broad conclusions about the climate response to global solar dimming remain robust*." Yet the previous sentence says: *"… the only major differences involve highly parameterized and uncertain processes, such as cloud forcing or terrestrial net primary productivity*." Cloud forcing represents a major uncertainty in nearly all aspects of climate prediction and is possibly the leading uncertainty overall. The scope of the current paper does not include a detailed examination of the way cloud forcing is parameterized in different models – whether they all use similar parameterizations, or whether they capture the full range of plausible parameterizations, or something else.

Fair enough. But as such, the paper does not show that the actual uncertainty in cloud forcing has minimal effect on the model results. One can say that available GeoMIP model simulations of the climate response to global solar dimming are in aggregate mostly consistent between iterations 5 and 6. However, one cannot claim that the actual climate response to global solar dimming is represented robustly based on the model comparisons provided. This distinction is subtle but important, especially as geoengineering is also a topic for policy makers, who might not appreciate the limitations of the models, and as a consequence, might make decisions based on assuming that the model results robustly reflect nature. (This note also applies to lines 202-204 and lines 225-227 in the Conclusions. I appreciate that there are now also some more evenhanded statements in the conclusions, but the texts in these two places remain as overstatements of the type discussed above.)

Additional Notes

Lines 16-17. *"… replicating the mechanisms that cause cooling after large volcanic eruptions (Robock, 2000)*." There are also some important differences between the proposed, continual geoengineering stratospheric injection and natural volcanic injections. This point is also made in some of Alan's papers.

Lines 27-28. "*Simulations of solar geoengineering with solar reduction have long shown that solar geoengineering would cool the planet, offsetting global warming*." However, the "offsetting" occurs only in a global-average sense. The following few sentences leave the impression that solar geoengineering would reverse changes in the hydrologic cycle, the cryosphere, extreme events, vegetation, circulation, etc., with the offsets just not necessarily being "exact" on a regional basis, not being able to "completely" offset climate change from greenhouse gases. This again understates the uncertainties – there might be far more "losers" than "winners," for example, and the models are by no means good enough to draw strong conclusions about this. The current paper could help, if this point is framed differently.

Lines 191-193. "*The sign of residual climate impacts (for example in temperature) are in better agreement in CMIP5 than CMIP6 (Table 3 shows a difference in stippled area between the two ensembles), but this could be a function of the smaller ensemble size in CMIP6*." It would be difficult to actually demonstrate this conjecture statistically, given the small numbers of models involved, and the current paper does not attempt it. An alternative interpretation of the observation would be that the factors affecting the signs of residual climate impacts are not well enough understood for the CMIP6 models to show improvement over CMIP5. Again, the current paper could help…