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Comment on acp-2021-1032

Anonymous Referee #2

Referee comment on "Assessing the consequences of including aerosol absorption in potential stratospheric aerosol injection climate intervention strategies" by Jim M. Haywood et al., Atmos. Chem. Phys. Discuss.,
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Review of Haywood et al., Assessing the consequences of including aerosol absorption in potential Stratospheric Aerosol Injection Climate Intervention Strategies,
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This study is examining impacts of absorbing aerosol injected with sulfate (which also partially absorbed) for stratospheric geoengineering. The responses noted are not new, in that some of these have been noted in papers using much more absorbing aerosol than employed here.

One example (which is referenced here) is the paper by Ben Kravitz (Kravitz, B., A. Robock, D. T. Shindell, and M. A. Miller, 2012. Sensitivity of stratospheric geoengineering with black carbon to aerosol size and altitude of injection. *J. Geophys. Res.* 117, D09203 (2012).) that discussed how using large amounts of black carbon for SAI purposes had potentially detrimental impacts on climate. However, Kravitz et al. used black carbon as the SAI material, and used a large amount, 1 Tg BC per year. As noted by references in this paper, it has been previously established that using BC as the SAI material causes detrimental effects, and, the Gao et al. proposal being criticized here also notes that issue. The Gao et al. paper uses .01 Tg/yr. The authors of this current paper note that they are using a factor of 10 more BC material in their assessment than Gao et al. did, and effectively introduce this study as a criticism of the Gao et al. proposal. However, because of that factor of 10, it's really not a fair criticism of the method. What would be a useful addition to this study is something akin to a toxicity study, where one determines at what concentration a substance is toxic. I recommend examining consequences at 1X, 3X and 10X the .01 Tg/yr case. This study is not including quite enough for BC to be the SAI material (like the 1 Tg/yr used by Kravitz), but it used way too much to be considered as a lofting material as discussed in Gao et al. Consider something like a medical supplement; a small amount of a vitamin is beneficial for health, but a large amount is detrimental. You would not then recommend not taking the vitamin at all because a large dosage is detrimental.

The other point that these authors missed in regards to the Gao et al. paper is that they used BC as an example, but also suggested using Brown Carbon for the initial lofting, which would then break down in the stratosphere, and the heating effects would be different.

A sensitivity study looking at varying amount from very small (.01 Tg/yr) to the values assumed in this study would be useful. Are the feedbacks and consequences really linear with the forcing? A sensitivity study could examine whether you get 10X the response using 10X the amount of BC. It could be smaller, or larger, and that would be useful to know.

Overall, it seems this paper was inspired by the Gao et al. proposal, but really isn't definitively proving or disproving whether the proposal is actually harmful or not. Something akin to a toxicology assessment would be really useful, and I'd encourage the authors to consider doing something like that.