

Interactive comment on “Expanding the Design Space of Stratospheric Aerosol Geoengineering to Include Precipitation-Based Objectives and Explore Trade-offs” by Walker Lee et al.

Anonymous Referee #1

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General comments: In this study, the authors explore how different climate objections could be met by injections of sulfate aerosols at four locations, based on theories developed in previous works. Different climate objections are represented as the 2-D surface in a 3-D graph, and the possibility to achieve multiple goals is evaluated by the relative relationship among these surfaces, which are further evaluated using model simulations. This work offers a new way to examine the relationship between experiment designs and outcomes and help evaluate limits and trade-offs of aerosol injection geoengineering. I just have some minor comments:

I would appreciate it if the author could provide more explanations or details about

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how the form of Eq.1 to Eq.3 in the paper is derived based on previous literature. Accordingly, I am not sure I fully understand how the mathematic form of the constraint (line 125) is derived. I would like to see this if possible.

Line 249: The global mean T and P cannot be managed at the same time using current injection design, but might be possible under other frameworks (e.g., Cao et al. 2017), which could be made clear here. REF: Cao, L., Duan, L., Bala, G., & Caldeira, K. (2017). Simultaneous stabilization of global temperature and precipitation through cocktail geoengineering. *Geophysical Research Letters*, 44(14), 7429-7437.

Line 420: The author conducted simulations that attempt to simultaneously restore three different climate variables, and evaluated the percent restoration in Eq.5. Since none of these simulations are able to restore all three climate goals, I think this raises the question about “what’s the most optimized climate state that has the smallest damages to the society”. I am not saying this should be done in this paper, but later maybe consider to balance different climate goals and use an overall restoration score for all these climate goals (and maybe also consider side effects on other variables, such as precipitation) would be helpful.

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