

Review on:
Injection strategy - a driver of atmospheric circulation and ozone response to stratospheric aerosol geoengineering

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The authors analyze the results of four simulations of different injection scenarios on stratospheric aerosol intervention (SAI), or stratospheric aerosol geoengineering as they say in the title. The area of injection changes from equator to mid latitudes. The simulations are partly new, especially the assumption for seasonally varying injections at 60N and 60S. The other injection strategies are similar to the GeoMip5 scenarios or previous publications. The authors analyses different impacts of SAI on stratospheric and tropospheric dynamics. The analysis of the simulations includes an interesting discussion on climate and tropospheric circulation, e.g. NAO. This important aspect has not been taken into account enough in existing literature. To me, this is the main aspect of the paper.

The paper is well written and reads well. I recommend publication after a few minor corrections.

Ulrike Niemeier

General:

As stated above, the impact of SAI on the tropospheric circulation is an important aspect in the discussion about SAI. Other parts, e.g. the impact on the Brewer Dobson Circulations, ozone or temperature have been discussed earlier. Here the authors should cite broader and discuss their work in relation to previous publications. They have to state clearly which aspects of the analysis are new. GeoMIP 5 scenarios used RCP4.5 forcing as well. They showed a rather small signal to noise ratio. Therefore, a short discussion why this paper bases SAI on RCP4.5 should be added.

You show mainly yearly averages in the main paper. The POLAR injections depend on season and have, therefore, very different seasonal aspects. This needs to be taken more into account.

I wonder a little about the title. A discussion on injection strategy is not new. The impact on high latitude tropical circulation and climate are far less discussed in previous literature. You use geoengineering in the title, but not again in the text. Stick to one of both.

Specific comments:

All Figure: Increase font size of the legend.

Introduction: Please put your work better into relation to previous work. Injection strategies have been discussed before. Why do we need another paper.

Methods:

Line 100: Generates the model a well developed QBO or more a QBO like pattern? The vertical resolution seems to me a bit low for a good QBO.

Line 104-105: SSP2-4.5 and the period 2035 to 2069 results in a low signal to noise ration. Why this scenario? The world in in 2023 on the 8.5 track.

Line 111: An injection altitude of 22 km is high. On the one hand, this kind of study aims a bit on better deployment strategies. On the other hand, the injection altitude would be difficult to do. So, why 22 km?

Do you have an ensemble or single simulations?

Line 120: Please, include Fig S1 into the main paper.

Line 124: POLAR... highest aerosols concentration... Where? Not in the annual mean.

3. Annual mean changes.....

An annual mean cannot cover the impacts discussed here. The strategy of polar is not annual. I wondered a bit, if some impacts were hided behind the annual mean. Add seasonal means here, the paper will clearly gain.

Line 157: .. discussed in or detail in Zhang..... Please quantify and add a few sentences.

Line 170: Do I understand this right, your model cannot calculate the RF of sulfate? No radiation double call?

Line 178-179: Fig 2 does not show a weakening of the gradient. The isolines show 200 K in the tropics and 220 in NH. This will not result in a stronger temperature gradient when warming the tropics. Change the plots and/or the discussion accordingly.

Line 180: Please be more precise. Which jets, where is the westerly response?

Line 180pp: This discussion is useless with plots of annual means. Add seasonal plots for the discussion of polar vortex, in case you mean polar vortex as you don't say so. Add seasonal plots in general, esp for POLAR.

Line 198: No enhanced gradient in your figure of temperature anomaly.

Line 236: Where do I see 15N+15S? Reference is missing.

Fig 4: TREFHT?

Fig 6: Precipitation changes between EQ and POLAR seem to be small and mainly over water. Changes over land might be more critical in POLAR.

Fig 5.2: Do we really get a good impression from yearly mean data? Changes under POLAR are strong as well and one may oversee important aspects this way.

Discussion:

This is mainly a summary. A discussion of the results is missing, e.g. which strategy may have stronger impact on land precipitation, monsoon (GeoMIP5 papers) etc. This is a single model study. There are many studies out to discuss shortly how much the results depend on the model.

Line 422: Temperature do not increase only in the tropical lower stratosphere.

Line 454: Bendarz(2022b): say a word about the content when cited here. The reader has to open the paper to follow you.

Please sort the reference list. Also, titles are missing.