

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2021-260

Daniele Visioni (Referee)

Referee comment on "Climate impact of volcanic eruptions: the sensitivity to eruption season and latitude in MPI-ESM ensemble experiments" by Zhihong Zhuo et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-260-RC1>, 2021

In this work the author analyze the climatic response to tropical and extratropical idealized volcanic eruption, simulating injections at three latitudes and two seasons, and describing the changes at the surface, focusing in particular on surface temperature, precipitation (with a focus on ITCZ shifts and Indian monsoon and cloud cover. The paper is scientifically sound, even if it has a tendency in places to repeat the same, somewhat obvious concept multiple times (like the fact that higher cooling is produced where the aerosols are localized), but it is overall interesting, and the size of the ensembles used allow for some interesting, robust observation. So I think the work can be published on ACP, but the text (and the quality of some figures) needs to be improved in places to make reading it easier. I have offered some suggestions below.

Abstract Using parenthesis that way makes the abstract unreadable. Better to use two phrases. Please see Robock, 2010 as to why <https://eos.org/opinions/parentheses-are-not-for-references-and-clarification-saving-space>. The same is valid for the whole text in multiple places!

L 18: "emphasizes"

Introduction

L 39: "have been thought" -> "are considered to be"

L 60: aims "to answer", no capital letter for "How"

Method

(add an s to "Methods")

Add information on chemistry used: I assume it's prescribed, but better to specify.

Line 93: which longitude? It's not specified here.

Line 102: "remains an unsolved question"

Line 113: maybe add "IVT = " to the equation?

Results

Line 127: see my comment in the Abstract about that use of parenthesis

Line 130: if the scale in Fig. 2 was a bit narrower (no point in plotting AOD after 1994), one could maybe tell how many months was the "several" said here? Or just specify the e-folding time of the plume.

Line 135: it depends on the specific of the stratospheric circulation, yes, which are dependent on the season. For instance, see Tilmes et al. (2017) and Visionsi et al. (2019) where we tested injections of SO₂ in all season at various latitudes in a systematic way with CESM1(WACCM) and the different transport paths are evident.

Line 154: I'm not sure what this confirms, other than the obvious observation that there is less solar radiation at high latitudes during winter?

Line 156: SR is *not* reflected at the TOA. We see it at the TOA (the model diagnoses it as such) but the SR is reflected *in the stratosphere* by the volcanic aerosols, thus decreasing SR reaching the surface and cooling the surface.

Line 204: aims to explain

Line 214-217: this entire phrase makes very little sense. Please rephrase. In which case does "the temperature difference between the hemispheres increases slightly"?

Line 220: how is the ITCZ calculated? There are various ways to do so. Is it the precipitation centroid? Global, or between certain latitudes? Or is it calculated with the position of the Hadley Cell? Please explain.

Section 3.5.2 and 3.5.3 are completely unreadable due to all those parenthesis.

Conclusions

Line 355: "*Because of this, extratropical eruptions in the northern (the southern) hemisphere (NH and SH cases) cause larger cooling over the northern (southern) hemisphere continents compared to the equatorial eruption (EQ case)*" I Have really no idea how to read this phrase: which one is the parenthesis that is supposed to be read first?

Figures

Some figures (2-3-4) are incredibly low resolution, and they're very hard to understand because of it. Make sure they are higher quality before resubmitting.

Figure 9 would benefit from being more specific in the titles for panels b-d that it is a difference with CTR, and not the full field, even if it says in the caption.

References

S., Tilmes, H., Richter J., J., Mills M., B., Kravitz, G., MacMartin D., F., Vitt,... F., Lamarque J.â□□ (2017). Sensitivity of aerosol distribution and climate response to stratospheric SO₂ injection locations. *Journal of Geophysical Research: Atmospheres*, 122, 12,591– 12,615. <https://doi.org/10.1002/2017JD026888>

Visioni, D., MacMartin, D. G., Kravitz, B., Tilmes, S., Mills, M. J., Richter, J. H., & Boudreau, M. P. (2019). Seasonal injection strategies for stratospheric aerosol geoengineering. *Geophysical Research Letters*, 46, 7790– 7799. <https://doi.org/10.1029/2019GL083680>