

This paper combines measurements and model simulations to assess the outcomes of the 2018 Ambae eruption. It is an excellent study, and more of this kind are needed to understand the shortcomings of climate models in simulating volcanic plumes evolution and the radiative effects of the increase stratospheric sulfate. I think this paper is great for ACP, it is scientifically robust and novel. I have multiple suggestions to improve the text in places (especially the readability in English) and I have listed them below, but I don't think this is generally an obstacle for the publication of a relevant advance in our scientific knowledge, so after these suggestions are considered, the manuscript can be published promptly.

Abstract

Line 2: "These effects are more noticeable after..."

Line 4: no comma after studies

Line 4: "Besides" is not the right word here. I'd actually rephrase the entire concept using: "There have been several studies, where a volcanic eruption plume and the associated radiative forcing were analyzed using *either* climate models *or* data from satellite measurements: however, studies combining both models and measurements are rare"

Line 11: remove "the", leaving "for most latitude bins"

Line 12: remove ":"

Line 17: "to the" instead of "through"

Introduction

Line 24: "is" now well established.

Line 41: this is a nice overview. However, it does not mention quiescent degassing and non-explosive eruptions that are also an important source of sulfate for the UTLS, see for instance Pitari et al. (2016)

Line 44-45: just to be precise, but it's not the models themselves, it's the underlying simulations without proper sulfate emissions. For instance, in Schmidt et al. (2018), they compare simulations with and without volcanic emissions *in the same model*.

Line 57: comma after volcanoes.

Line 58: "in" instead of "of"

Line 62: "...the last decade, although it did..." (just fixed the punctuation)

Section 2

Line 127: remove comma after "highlight"

Section 3: I'm a bit confused by the structure of the sections: wouldn't it be better to have a Section 2 with a description of both the measurements (OMPS, SAGEII) and possibly the ECHAM simulations, and then move to the results? it would be a bit clearer to the reader.

Line 153: "Ångström" is missing an s (but it has all the correct accent marks, which usually nobody bothers with!)

Line 159: no comma after "Both"

Line 164: no "the" before the dates

Line 168: this is my ignorance, being a modeler, but how can there be negative Extinction values? Is it an error in the retrieval algorithm (and if that's the case, why not remove them?). Or something else? If it can be briefly explained, it should be.

Line 178: "observed" instead of "seen"

Line 187: I see what the authors mean, but "put" is not the right word. If the original observations were spatially non uniform, and the authors obtained a uniform grid out of them, then it's technically a 2D interpolation.

Section 4

Line 202: remove "the" before height

Line 206: a *periodicity*, or periodic signal

Section 5

Line 216: remove "the" before altitudes

Line 217: "However" instead of Although

Line 229: northward and southward

Section 6: Again, it's a bit weird to have Fig. 3 with the ECHAM results before a description of the simulations. I'd have most of this section much earlier in the text.

Line 247: for two reasons.

Line 261: the phrase "Furthermore, the radiative cloud fractions less than 0.2 and a solar zenith angle less than 70° were required" doesn't make sense to me.

Section 6.2: this section is explained in an excellent way, but I have a doubt that I can't seem to find in the text: what's the horizontal extent of the SO₂ in these measurements? I.e. when the authors say "Finally, the SO₂ mass of the entire grid per batch are summed up to obtain the total SO₂ burden.", what's the horizontal span of the grid that contains, say, 99% (or 95%) of the SO₂ used in the estimates you present for the volcanic eruption? This is potentially an interesting point to include.

Line 326: "vertical" instead of "altitudinal"

Line 335: most aerosols are

Line 339: "blob" is not a very technical word... Maybe just "area"? (also in line 376)

Section 7

Line 360-361: just a comment, but I'm also quite amazed at how well the plume is reproduced in ECHAM! This is a great result.

Line 368: "with" observations

Line 374: observed instead of "seen"

Line 382: is the SO₂ amount big enough to produce a noticeable w^* increase produced by the heating? Can the authors give some information on the stratospheric temperature perturbation? (the nudging ensures that this doesn't translate in additional w^* , of course, but can we actually see an effect on stratospheric temperatures with 0.4 Tg-SO₂?)

Line 384: "The" Amba eruption

Figure 6: there might be some problem with the legend: the (869) part is missing.

Line 422: “the” reader’s attention

Line 433-434: how do you estimate the 0.13 W/m² value? Doesn’t look like it’s the value from the green line only. Is it an average between all curves? Some? An explanation is warranted.

Conclusions

Line 446: “observed” instead of “seen”

Line 447: “the” tropics

Line 449: “global aerosol model” is not really precise? I’d suggest using “GCM with a coupled aerosol microphysical model”

Line 453-456: This phrase is a bit confusing. I’ve tried to reword it below a bit

“For the first eruption ECHAM underestimated the strength of the plume as well as the time by which it reaches 20.5 km of altitude, whereas for the second eruption the modeled plume reaches higher altitudes about two to three weeks earlier, and the plume lives longer while being slightly weaker overall at those altitudes”

Line 459: “the” aerosol radiative forcing

Line 461: the time “evolution” is a better term

Line 466: “the model” with no “s”. Can’t assume the same for other models...

References

Pitari, G., Visionsi, D., Mancini, E., Cionni, I., Di Genova, G., & Gandolfi, I. (2016). Sulfate aerosols from non-explosive volcanoes: Chemical-radiative effects in the troposphere and lower stratosphere. *Atmosphere*. <https://doi.org/10.3390/atmos7070085>