

Editor Comments

Dear Authors,

I am pleased to share that the third reviewer is satisfied with your submission. Please consider addressing the reviewer comments. I am happy to accept your manuscript, pending mostly minor comments.

Thank you very much for the kind words and for the much appreciated serious work of supervision of the peer-review process for our paper. Please find our replies (in blue) to your comments (ECx) and those of the additional reviewer (RCx).

EC1) L10 “One notable effect of the Hunga eruption was the significant modification of the size distribution (SD) of the stratospheric aerosol layer with respect to background conditions and other recent moderate stratospheric eruptions, with larger mean particles size and smaller SD spread for Hunga.” Please change to: In comparison to background conditions and other recent moderate stratospheric eruptions, one notable effect of the Hunga eruption was the significant modification of the size distribution (SD) of the stratospheric aerosol layer, resulting in larger mean particles size and smaller SD spread for Hunga.

Agreed and done

EC2) L34 Millàn -> Millán (i.e. please use an acute accent mark)

Sorry. Done.

EC3) L34 please add: Khaykin, et al <https://doi.org/10.1038/s43247-022-00652-x>; Vomel et al 10.1126/science.abq2299

Done

EC4) L40: with “The Hunga stratospheric aerosol perturbations were persistent at the southern-hemispheric scale” are you trying to say that it lasted (temporarily) longer than usual in the southern hemisphere or that it encompass the entire southern hemisphere? In any case persistent may not be the most suitable word. Please rephrase / clarify

We modified the sentence to “The Hunga stratospheric aerosol were quickly transported meridionally (weeks-to-months timescales) and stratospheric aerosol perturbations were soon observed encompassing the whole Southern Hemisphere (Legras et al., 2022, Taha et al., 2022). The Hunga aerosol layer showed optical signature of ash only for...”

EC5) L51: Missing period after (Li et al., 2024).

Added, thanks.

EC6) L61 and the rest of the manuscript: El Chichon please change to: El Chichón

Yes, done in the text and figures

EC7) L63: I don't think this “This paper is structured as follows: in Sect. 2 the data 3 and methods used in the paper are described; in Section 3 results are shown and discussed; conclusions are drawn in Section 4. ” is really needed. But you can leave it if you prefer.

We prefer keep it.

EC8) L71 and L78 Please use subscripts for H₂SO₄

Corrected.

EC9) L79: is 215K Really mid-stratospheric temperature. I think this temperature is really more like

lower stratospheric temperature. In any case, wasn't the aerosol plume mostly in the lower stratosphere?

Yes, but parts of the plume were at higher altitudes in the mid-stratosphere. We corrected the sentence to account for this.

EC10) L103 Consider deleting "in 1991" it was mentioned in the line above.

EC11) L109 Consider deleting "in 1982" it was already mentioned.

Yes, good idea. Done.

EC12) Figure 2: Please consider using thicker lines (also for Figure 4 and 5). Consider using the same x-axis limits in the panels so that the reader can easily intercompare the two. Why are the labels for sigma in red? The sigma distinction is made by the line type (i.e., dashed, solid, etc) so these legends should be gray (since it cannot be black because that color is being used for the background). Please change these sigma legends for figure 4 and 5 as well.

Thicker lines now done for Fig. 2. We tried the same for Figs. 4 and 5 but this made figures too busy, so we keep them as they were. Making x-axis limits the same in panels a and b makes actually panel a very less readable (red and yellow curves superposed) so we don't change but mention this in the caption. For the sigma colours: yes, very good idea! In our intentions, that red shade was kind of an "average" colours for the Hunga cases (orange to dark red) but we see that this is not so clear. So, we changed to grey (and same in Figs. 4 and 5, as well as in the Supplementary figure S1).

EC13) Figure 2 caption: There is no mention of the panel B. Although the description is there.

Added.

EC14) L139 Please consider rewriting this sentence "Values of the SSA approaching 1.0 (0.0) point at pure scattering (absorbing) particles" and L141 "Values of the g parameter approaching 1.0 (0.0) point at pure forward (isotropic) scattering." The use of this type of parenthetical structure can be confusing for many readers <https://eos.org/opinions/parentheses-are-not-for-references-and-clarification-saving-space>

Good point! Corrected.

EC15) L152 "and this latter impact is probably underestimated" Please consider changing to "likely leading to an underestimation of its impact."

Agreed and done

EC16) Figure 3 caption: "Scheme" change to "Schematic"

Done

EC17) Figure 4: The vertical dotted lines are barely visible. Also they are 2 different shades of blue (I think by zooming a lot into the PDF). Please change the caption to something like: Light and dark blue and vertical lines indicate the Uv/Vis and MIR bands used in Figure 7.

The dotted lines are now thicker and we changed the figure caption.

EC18) Figure 6: Delete 1991

Done in the caption.

EC19) L276 ...SW scattering (pink triangle in Figure 7)

EC20) L277 ...the ageing of the plume, pink squares)

EC21) L278 ...SA, pink hexagon)

Yes, why not. Done.

EC22) Figure 7 caption: and Pinatubo (pink large squares) and El Chichón (pink hexagon)
[Corrected](#)

EC23) Table 2: I suggest adding one extra column stating Uv-Vis, NIR, MIR, and FIR
[Yes, added](#)

EC24) L 337 presumably missing comma in “(-0.012-0.040 and -0.015 ...) Please double check
[It actually was meant to be an interval. We clarify in the text now](#)

Reviewer #3 Comments

The primary outcome of this study is that the authors used size distributions provided by Duchamp et al. (2023), for both the Hunga perturbed and the background stratospheric aerosol layer to determine aerosol optical properties. Then the aerosol properties has been compared with other volcanic eruptions. This work used the Mie code provided by my current group (EODG) in Oxford. The manuscript is written well, and the results are discussed in an appropriate way. I would like to recommend this manuscript for publication with minor corrections. The authors have already put in significant effort, especially as the manuscript has undergone a round of review by other reviewers. I do not wish to add any extra burden; however, I hope the minor comments listed below will be helpful if the authors choose to consider these changes. Overall, the manuscript is well-structured, easy to follow, and a pleasure to read.

[Thank you for your kind words. Please find our replies to your comments in the following.](#)

RC1) Line 42: “The Hunga stratospheric aerosol perturbation can then solely be associated to SA”. This might be mostly due to the look-up tables. These LUTs might be missing the crucial information about the stratospheric ash particles. Thus it would be very nice to mention this in this line.
[It actually is an evidence of many previous studies, including different satellite, ground-based and in situ measurements, including Sellitto et al., 2022a and Legras et al., 2022 cited in the Introduction of the present manuscript.](#)

RC2) Line 65-66: “As discussed in the introduction, both the background stratospheric aerosol layer and its perturbation brought by the Hunga eruption can be solely characterised, in terms of composition, as secondary SA particles.” This sentence is not simply true, as I mentioned that the satellite based retrieval algorithms might be missing the crucial information about the presence of Ash particles. Please mention this in this sentence. Thus the assumption of SA are only considered. This logic makes sense.
[See my reply to RC1.](#)

RC3) Line 76: For the selection of 215K temperature, is it possible cite some recent publications instead of 1988 publication? Because due to climate change the stratosphere is rapidly warming.
[Hummel et al. \(1988\) do not discuss stratospheric temperatures and their trends but just describes his CRI dataset, from laboratory measurements, at different temperatures. This dataset have SA CRIs at just a limited number of temperatures, but is the one we can use because of the simultaneous availability of SW and LW CRIs \(which is not often the case in CRI databases\). This CRI temperature is the most adapted, among those available, to represent the lower and mid-stratospheric conditions \(see also EC9\).](#)

RC4) Further, is it possible to increase the figure quality?
[Not in terms of the spectral resolution because this is the full spectral resolution of the Hummel et al. \(1988\) CRI dataset, unfortunately.](#)

RC5) Would it be possible to add a paragraph in the conclusion section discussing future directions? Specifically, it would be valuable to outline potential approaches for improving results and comparisons when analyzing the Hunga eruption, which has more extensive observational data, in contrast to the El Chichón and Pinatubo eruptions, where such data is limited.

[We added a sentence on the importance of aerosol SD for radiative impact estimations.](#)