Referee comment on acp-2021-448
Anonymous Referee #3

Referee comment on "The 2019 Raikoke volcanic eruption part 2: Particle phase dispersion and concurrent wildfire smoke emissions" by Martin John Osborne et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-448-RC3, 2021

This paper presents a study combining NAME model simulations with satellite and ground-based observations to determine the composition and origin of aerosol plumes over the United Kingdom. This involved analyzing the long-range transport of stratospheric aerosol in the Northern Hemisphere and the optical properties of the aerosol to identify the source of aerosol from biomass burning by wildfires in Canada, as well as volcanic ash and volcanic sulfate aerosol from the Raikoke volcanic eruption in June 2019. Finally, both signals could be well separated from each other using the described technique.

The paper is well written and I have mostly minor comments on the figures and technical corrections. I have made some technical notes in the attached pdf file.

General comments:
I have a question to clarify the implementation of emissions in your model simulations: You used "a series of stacked and staggered cylinders" to implement the vertical emissions from the forest fire. If I understand you correctly, you are using a column above the volcano with a vertical SO2 emission profile from the first paper, but not individual cylinders as for the forest fire emissions? You also used a vertical profile for volcanic ash implementation. But I can't find a vertical profile for the implemented forest fires. So how did you scale the 0.1 Tg of material released in each cylinder? Could you briefly describe how you calculated the mass, size, height and position of these cylinders? Could you also provide a vertical profile for the implementation of the forest fires, similar to Figure 2?

Specific comments:
p.15 l. 325: The value 25 µgm^-3 does not fit the scale in fig. 5c.

Figure 4 and Figure 7: For some people, it might be difficult to distinguish between these colors: 0; 7; 9; 10
Figure 5: The caption does not belong to figure 5 -> figure 6.

Figure 8b: Panel 8b is not described in the text. What is panel 8b (volume depolarisation ratio) needed for?

Figure 11: The units in figure 11 are log10 VDR [AU] and log10 RCS [AU], but in the text you use PDR [%]. Maybe you might highlight the most important spots, as in Figure 5, to clarify the description in the text on p. 24-26.

Technical corrections:

You mix different spellings of sulphate/sulfate in the text e.g. p. 7 l.176/177. In part 1 paper you used sulfate.

End all captions of figures and tables with: “.”

Check that there is always a blank between the value and the unit.

Title: part 2: In the first part of your study you wrote: … - Part 1: …

p. 6 Table 1: double parenthesis ((1999); “blank” between (2007), used

p. 7 l.156: “blank” between Raikoke eruption

p. 7 l.172: No reference for de Leeuw et al. (2021). Do you mean 2020?

p. 8 Figure 2 l.4: the SO$_2$ product

p. 9 Table 2: at 532 nm

p. 12 l.252: cm$^3$

p. 13 l.261: right-hand column

p. 13 l.271: SO$_2$

p. 13 l.278: “blank” 532 nm

p. 14 l.320: “blank” 13 km

p. 19 l.379: 57°N and 60°N

p. 19 l. 393: Petzold et al., (2007)

p. 20 figure 7: “blank” 532 nm

p. 22 figure 8: [m$^{-1}$sr$^{-1}$]

p. 22 l.408: 77°N are out of range of figure 6.

p. 23 figure 9: [number per cm$^3$]

p. 25 l.436: panel A
p.25: Check the parenthesis of your citations.

p.27 table 5: Formatting: X km for each entry

References: Please double check the format of your references ONE BY ONE to make sure they are in the ACP reference format: e.g. n/a–n/a, two web links, ...

Please also note the supplement to this comment: https://acp.copernicus.org/preprints/acp-2021-448/acp-2021-448-RC3-supplement.pdf