

RESPONSES TO REFEREE

First of all, the authors acknowledge the referee and the editor for the time spent to review this manuscript and also for their constructive comments. The modifications are indicated by italic and red bold fonts in the revised manuscript.

REFEREE 1

Two very minor corrections:

- Fig. 6, the letter "u" is missing from Calbuco in the figure

Authors : This typo error was corrected in the revised manuscript

- Some of the references added in the text were not added in the bibliography. For instance, the two Pitari et al., 2016 references. I suggest the authors have a last check to be sure this is fixed and in case some more have been left out.

Authors : This reference was added in the bibliography.

REFREE 2

Minor revisions:

1) Page 2, line 27 and 28 -- the revised manuscript now has improved sentence in lines 25-29 but whilst the Froyd et al. paper is a good reference for the presence of the organic material, for the meteoric influence, I recommend instead citing the Mossop (1965) paper which presents the observations of the refractory cores within the stratospheric aerosol particles, and to also cite Murphy et al. (1998) as the paper that demonstrated the meteoric signature from the PALMS measurements.

I am suggesting just to add "Mossop (1965), Murphy et al. (1998)" there, and suggest to remove the citation to Neely et al. (2011) in this particular sentence as these earlier studies were the key papers.

Authors: The reference recommended by the referee was included in the revised manuscript

2) Please add Guo et al. (2004) to reference list -- see citation below.

Authors : This reference was added in the revised manuscript

3) Page 11, line 13 -- change "9% precision" to "9% error"

Authors : This sentence was corrected as suggested by the referee

4) page 14 lines 29-30 -- this sentence does not make sense. Please re-word or remove. Also typo: horiz resolution says 500km but I assume you mean 50km?

Authors : We followed the suggestion of the referee. As a consequence, this sentence was removed to the revised manuscript. Moreover, the typo error point out by the referee was corrected.

5) page 14 line 33 -- Re-word this sentence "possible for solid aerosols such as ash to be incorrectly identified as ice nuclei" -- this sentence doesn't make sense -- please clarify or perhaps this sentence could be deleted?

Authors : We understand the point of view of the referee. As a consequence, this sentence was deleted in the revised manuscript.

6) Page 15 line 12 -- "daily-integrated LiDAR" -- I don't understand what you mean here -- suggest to delete "daily-integrated" or maybe you meant "once-per-day"? -- If so then just say "daily" not "daily-integrated".

Authors : This sentence was re-written in the revised manuscript

7) Page 15, line 15 -- typo: replace "DV" with "dV".

Authors : This typo error was corrected as suggested by the referee

8) page 15, lines 20-21 "too low to properly detected by" -- there are a few missing words in this sentence, please re-word.

Authors : This sentence was re-written in the revised manuscript

9) I noticed that in the reference list there was a Kravitz et al. (2002) reference for a paper on stratospheric geoengineering with black carbon -- that is a 2012 paper not 2002. But more than that it is not cited in the paper so should be removed.

Also Jaeger and Jegou references need to come before those beginning with K.

Authors : The reference mentioned by the referee was removed to the revised manuscript. Moreover, the reference were classified by alphabetical order.

10) Page 16 lines 4-7 -- this sentence referring to growth and loss processes in the Pinatubo plume is too detailed for this paper --- it's good that you have the previous sentence giving this context, but this is too much information for this paper here. Also that is not correct that "particle loss" tends to reduce effective radius. If the words "new particle formation" were used instead of "particle loss" that could work -- and could keep that sentence if that change was made -- but my feeling is that this paper is not the right place to present this further discussion of the Pinatubo case.

Authors: We understand the point of view of the referee. As a consequence, the lines cited by the referee were removed to the revised manuscript.

11) The authors have revised the caption to Figure 8 (now referring to ground-based and space-borne lidar rather than just lidar and CALIOP). That improved that caption. The same change should be made to the caption of Figure 7 (that still has the wording Figure 8 originally had before the revision was made).

Authors : The caption of Figure 7 was modified like as the caption of Figure 8 (as suggested by the referee).

12) Page 16 -- the new text has "per cm³" in several places in the text. Please revised to "cm⁻³" i.e. follow the ACP recommended way of denoting "per cubic centimetre".

Authors : We took into account the ACP recommendation. As a consequence, we revised “per cm³” to cm⁻³.

13) Page 17, lines 30-31 -- the new sentence here does not make sense and needs to be re-worded. It currently says "As a consequence, the transport of the Calbuco plume at another isentropic level associate to another pathways described above is possible." -- please re-word.

Authors : This new section was re-written in the revised manuscript.

REFREE 3

Page 2, lines 6–7:

The following sentence is meaningless without a comparative adjective: “The aerosol number concentration was ~20 times that observed before and one year after the eruption.”

It should be: “The aerosol number concentration was ~20 times higher than that observed before and one year after the eruption.”

"Southern Hemisphere" instead of "southern hemisphere" should be used throughout the text of the paper.

There are problems with the *singular* and *plural* numbers of some words in the paper. For example, as the words “aerosol” and “aerosols” are *singular* and *plural*, respectively, it should be either “aerosol affects” or “aerosols affect”, but not “aerosol affect” (see, e.g., Page 2, lines 15, 18, 26, etc.).

There is also the problem with the use of the terms “*height*” and “*altitude*” throughout the text and figure captions (see, e.g., Figure 2 and its caption).

Authors : The sentences point out by the referee were corrected in the revised manuscript. Moreover, we took care to be consistent with the use of the term “altitude” in the revised manuscript and also with the plural numbers of some word such as the word “aerosols”.

Page 3, line 7: “The eruption of ~~the~~ Pinatubo...”

Authors : It was corrected in the revised manuscript

Page 3, lines 24–26:

Instead of

“Three moderate volcanic eruptions are ranked in the top 10 of the most influential events on the stratospheric aerosol burden including ~~during the 2002-2012 period:~~”

Should be

“Three moderate volcanic eruptions occurred in the 2002-2012 period are ranked in the top 10 of the most influential events on the stratospheric aerosol burden including:”

The following references additionally introduced in the paper are absent in the list of references (at the end of the paper):

Pitari et al. (2016a),

Pitari et al. (2016b),

Solomon et al. (2016),

Ivy et al. (2017).

Note also that References are still not in alphabetical order.

Authors : It was corrected as suggested by the referee and these references were added in the bibliography. Moreover, we classified the references in alphabetical order and the missing references were included in the revised manuscript.

Page 6, line 25:

Instead of

“... from ground to mesosphere, ...”

Should be

“... from the ground to mesosphere, ...”

Authors : It was corrected as suggested by the referee

Page 7, lines 21–22:

Instead of

“...estimated to be $\pm 20\%$ and $\pm 60\%$ at particle concentrations lower than 10^{-1} and 10^{-2} cm^{-3} .”

Should be

“...estimated to be $\pm 20\%$ and $\pm 60\%$ at particle concentrations lower than 10^{-1} and 10^{-2} cm^{-3} , respectively.”

Authors : It was corrected as suggested by the referee

Page 8, line 22: “...launched ~~on~~ in October 2011”

Authors : It was corrected as suggested by the referee

Page 9, line 4:

Instead of

“temperaure” (the second *t* is missed)

Should be

“temperature”

Authors : It was corrected as suggested by the referee

Page 10, line 5: “... ~~the~~ Calbuco erupted on ...”

Authors : It was corrected as suggested by the referee

Page 10, lines 17–19: According to the data published by Jegou et al. (2013), this sentence should be written as: "The maximum SO₂ total mass (0.41 Tg) emitted during the Calbuco eruption was about two times lower than the maximum value (0.9 Tg) emitted from the Sarychev eruption (0.9 Tg) in June 2009 (Jégou et al., 2013)."

Authors : This sentence was re-written

Page 10, line 21: “Figure ~~2~~-1 also ...”

Authors : It was corrected in the revised manuscript.

Page 10, lines 29–30: “On 6 May, the plume is mainly located over the ~~Indian~~ Ocean near the ~~east~~ coast of South Africa and partly over Namibia and South Africa.”

According to *Figure 2c (6 May)*, this sentence should be written as: " On 6 May, the plume was mainly located over the Atlantic Ocean near the west coast of South Africa and partly over Namibia and South Africa.”

Authors : The referee is right. The sentence was corrected.

Page 10, line 32:

Instead of

“... sulphuric acid which further converted into...”

Should be

“... sulphuric acid which is further converted into...”

Authors : It was corrected in the revised manuscript.

Page 11, line 16: I understand that SR means the "scattering ratio" here, but this abbreviation (SR) has not been introduced before.

Authors : It was corrected in the revised manuscript

Page 11, lines 20–21: “... when ~~the~~SO₂ is still being converted (Fig. 1).”

Converted into what? Please, clarify it.

Authors : This sentence was re-written in the revised manuscript

Page 11, line 27:

Instead of

“...corresponds to the period ~~where the~~SO₂ ...”

Should be

“...corresponds to the period when SO₂ ...”

Authors : It was corrected in the revised manuscript

Page 12, line 1: “Figure ~~5d-5b~~ also ...”

Authors : It was corrected in the revised manuscript

Page 12, line 4:

Instead of

“... the phase of the ~~quasi-biennial oscillation (QBO)~~...”

Should be

“... the phase of the QBO ...”

Authors : It was corrected in the revised manuscript

Page 12, line 14: “... in Figure 5a and ~~5d-5b~~...”

Authors : It was corrected in the revised manuscript

Page 14, lines 17–18: “We note that the vertical resolution of OMPS is 10 times lower than the ground-based LiDAR with 0.15 km and 1.5 km respectively (Jaross et al., 2014).”

May be "1.5 km and 0.15 km" instead of "0.15 km and 1.5 km"?

Authors : This sentence was re-written as suggested by the referee.

Page 14, line 18:

Instead of

“(Jaross et al., 2014)”

Should be

“(Jaross et al., 2012)”

Authors : It was corrected in the revised manuscript

Page 15, line 1: “... solid aerosols such ~~ash~~-as ash ...”

Authors : This sentence was removed to the revised manuscript

Page 16, line 8 and Page 41, line 8:

The description of the particle sizes in Page 16, line 8:

“The integrated number of particles obtained over the full 19 size classes from 0.2 to 2 μm in diameter is presented in Figure 10.” and the Figure 2 caption:

**“Figure 10: Total number concentration of aerosols (0.2-50 μm) profiles obtained from ...”
*contradict one another.***

Authors : This sentence was corrected in the revised manuscript.

Page 34, line 7 (The caption of Figure 3): “...over ~~the~~ South America ...”

Authors : It was corrected in the revised manuscript

Page 41, lines 10–11 (The caption of Figure 10): “The aerosols layer is delimited by two horizontal black lines.”

The mentioned black lines are absent in Figure 10. Please, compare Figure 10 in the Revised paper with Figure 9 in the Discussion paper.

Authors : The caption was updated