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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Volcanic impact on the climate – the stratospheric aerosol load in the period 2006–2015" *by* Johan Friberg et al.

Anonymous Referee #1

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This contribution to our understanding of stratospheric aerosol optical depth (AOD) focuses on the CALIOP backscatter data set after it is cleared of clouds. A significant fraction of the paper is devoted to a procedure to correct CALIOP measurements beneath volcanic clouds when the laser is attenuated by the volcanic cloud. The procedure is relatively straight forward, although I found the discussion of how the threshold is set to instigate the procedure, and the relevance of Figure 3 to that procedure, confusing. I don't have specific suggestions to help here, but perhaps the authors could have a close read of this part to see if it may be improved.

Then the procedure is applied and the CALIOP data set presented over the 14 year period. The results are quite interesting and I appreciate the separation of the stratosphere into three layers associated with their relevance to cross tropopause transport.

This separation led to some nice generalizations concerning the volcanic eruptions which occurred over the 14 year period and how these eruptions influenced AOD and hence the cooling associated with stratospheric aerosol.

The paper is interesting, especially once the data are discussed, and should be published. There are a few things that need to be taken care of before that happens.

Aside from the detailed comments below the authors should add labels a), b), . . . to all the figure panels. The authors are very good at explaining what each of the a), b), . . . panels are in the captions, and refer to Figure Xa in the text. But none of the panels in the figures have labels.

Overall the writing is quite good, but there are a few awkward places. I have tried to flag these. One general comment the phrase "in order" is never necessary and can be deleted with no change in the sentence meaning.

1.9-11. Why switch between CALIOP and CALIPSO in the abstract when neither are defined. CALIOP is the instrument and should suffice in both places.

1.19-20. Awkward sentence, beginning with "of which". Try. Trends in the abundance of aerosol particles are an important component of the climate system, although their influence on climate is still highly uncertain. . .

2.10-14. Change forming to contributing. If OCS is known to form the Junge layer (which it isn't) then why the discussion about so2?

2.21 LMS? -

5.20 residing . . .

6.9 becomes . . .

7.29-31. This is confusing. Why would you expect aerosol scattering to compare with extinction? There is at least a factor of 50 between them. In Fig. 3 it is much more. The AS is noted in a range of 1e-8 to 1e-7, while the extinctions range from 0.02-0.1.

Fig. 3. There are no labels a), b), . . . Why is there a big 0 between the panels at the bottom?

8.1 Where is Fig. 2b? There are no labels on Figure 2 either. Why strangely?

11.2 first 8 months . . .

11.3. Are these the averages, maxima, value after 8 months, or?

11.28-29, "A feature appearing in the southern tropics in April has been identified as smoke from bush fires in February 2009 in Victoria, Australia (Vernier et al., 2011)." Is this the feature near 20 km, if so it is worth mentioning the altitude as this may be surprising for some. Best to be clear.

Figure 6. Perhaps the vertical solid lines represent the tropical eruptions? The figure caption is confusing. Please add short labels to the eruptions, which are listed in Table 1, so the reader can easily see the effects from Sarychev, Calbuco, and Kasatochi, without having to search them out. Similar labels would be appreciated in Figures, 5, 7-9.

13.18-19. What PV levels are considered the LMS. This is needed to understand the statement, "the aerosol signal is strong also in the lowest LMS layer of Fig. 6a". What is the lowest LMS layer?

13.25. The discussion previous to this conclusion has been descriptive of Figure 6, but it's not clear why the last half of this sentence holds. The volcanoes affected all the PV layers investigated more or less equally. It would be nice to see a PV level that wasn't affected, then maybe there would be a justification for the choice.

14.6-7. This conclusion about the source of the springtime increase in aerosol scattering is much too strong based on the evidence given. What do "These observations" refer to, to the work here or that by Martinsson? Perhaps they "suggest", but "indicate", no. Much more work would be required to come to such a definite conclusion.

Figure 8. Why don't the sum of the three lines add up to the total? There is usually at least a difference of 0.002 in AOD between the sum of the three layers and the total.

14.26-29. This is a bit surprising. Can some more detail be provided? Using Figure 6 the spring time maxima in 2007 and 2008 indicate SR in the lowest layers equivalent to the SR after Nabro, which shows a large AOD. Is it the fact that the impact of the dust layers, or whatever is causing this, so narrow that the impact on AOD is small?

15.3. The small peak near the equator in the upper layer can hardly be considered to be "high AOD". It is only slightly higher than in the mid latitudes.

15.26-31. It would be helpful to indicate here that Figure 7 is being discussed. This is the figure I used to follow the discussion.

16.4. "A small sudden increase in the AOD is observed in the southern extratropics approximately one and a half years after the Kelut eruption." At what level? Which figure is being referred to?

16.8-9. "The aerosol in the upper layer is eventually transported out to the next lower layer at midlatitudes, i.e the one located between the 380-470 K isentropes." It would be nice to know what figure is being used to make this claim. Figure 7 for example does not support this statement.

19.2. ". . . forcing, and is added . . ."

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