Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-1173-RC4, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Lidar ratios of stratospheric volcanic ash and sulfate aerosols retrieved from CALIOP measurements" *by* Andrew T. Prata et al.

Anonymous Referee #1

Received and published: 18 March 2017

General

The paper is well written. Carefully analysed CALIOP observations are presented. The paper is appropriate for ACP.

The only negative and confusing point is that obviously the volume depolarization ratio and volume color ratio are used instead of the particle depolarization ratio and particle color ratio. But I am not sure what is shown. The authors have to clarify that when discussing equations 1 and 2, see details.

Minor revisions are at least required. However, major revisions (switch to particle depolarization ratio) would significantly improve the paper.

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Discussion paper

Details:

Abstract:

P1, L9: Please state the wavelength (532 nm) again in the case of the volume depolarization ratio.

P1, L10-12: A volume depolarization ratio of 0.08, 0.05, 0.25 tells us almost nothing as long as we do not know the backscatter ratio (total-to-Rayleigh backscatter). So again, why not trying to determine the particle depolarization ratio? At least for a few examples.

Introduction:

P2, L22: Later on, in this paper, you mention the Mattis paper which also deals with the same volcanic eruptions in the high northern latitudes in 2008 and 2009. I checked that paper and found lidar ratios and depolarisation ratios for 355 and 532 nm for high-northern-latitude volcanic aerosol in the upper troposphere and stratosphere.

So, I was surprized that you did not give any reference to this paper in the introduction. Is there a specific reason, or did you simply forget? Mattis found lidar ratios of 30-40sr for 532nm and 60-80 sr for 355nm in August 2008 (upper troposphere, clearly related to volcanic aerosol), and 30-50sr for both wavelength between 14-18 km height one year later. And, by the way, Mattis found volume depolarization ratios of 0.015. Such low numbers really indicate sphercial particles, in contrast to your high numbers of 0.05 to 0.08 for the volume depolarization ratio, so that I started to think about the particle depolarization ratio.

So, please give proper reference to that Mattis paper in the introduction!

Instead, you mention papers that deal with volcanic layers in the lower troposphere. Please give the heights of these volcanic layers so that the reader can make his/her own conclusion how useful such information is in a paper dealing with stratospheric volcanic layers.

P4, L19-20: Again, I am not very happy that you do not make any attempt to provide particle depolarization ratios.

Section3: I appreciate the careful consideration of potential multiple scattering effects!

Now, I got confused! Equation 1 leads, to my opinion, to the particle depolarization ratio. Right? Please clarify that! Are these cross and co-polarized backscatter coefficients for particles???? or for the total (Rayleigh plus particle) backscattering. Please make that very very clear!

If that is for the total backscatter then please put an index 'p' to the ones in equation 2!... or are these total (Rayleigh plus particle) backscatter coefficients as well???

I got confused because equation 3 deals with the Fernald 1972 approach! So, you have the potential to compute particle backscatter coefficients and particle depolarization ratios when using the later Fernald method (Appl. Opt.l, 1984). So, why not presenting particle related quantities: lidar ratio, depolarization ratio, color ratio?

Figure 2 is very nice, but I am missing the particle depolarization ratio, and obviously the color ratio is also for Rayleigh plus particle backscatter coefficients, and thus not very helpful. . .. But, at the moment, I am not sure what is shown.

All the results in the figures are nice (figures 5,6,7,8 ,9), but I am still confused to see PARTICLE lidar ratios together with information on VOLUME depolarization ratios and VOLUME color ratio.

Correlations (Fig.9)1of PARTICLE lidar ratio versus VOLUME depolarization ratio are poor!!! Apples and oranges are correlated, to my opinion.

May be it is simply not easy to compute particle depolarization ratios and particle color ratios. But at least a figure showing both, the volume and particle depolarization ratio and maybe the same for the color ratio is required to convince the reader that such correlations as in Figure 9 are useful.

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