

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

## **Anonymous Referee #2**

Received and published: 3 March 2017

The paper by Prata et al. presents lidar ratio of stratospheric volcanic ash and sulfate aerosols retrieved from CALIOP measurements; an important quantity for deriving aerosol properties from a backscatter lidar like CALIOP. The paper is well suited for publication in ACP after consideration of the following comments:

General comments:

The description of the used method is hardly to follow for a reader less experienced with this method. The manuscript often refers to former papers for important equations. The chapter should be reworked in a way that all important points are included in this manuscript. It should also be clearly worked out why the a priori lidar ratio which was used for the calculation of the particle backscatter coefficient and the effective two-way

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transmittance does not affect the retrieved lidar ratio.

Minor comments:

The mean depolarization ratio for Puyehue in the abstract (0.28) differs from the mean value given in Table 2 (0.29).

You report about an exponential decay in the mean depolarization ratio for the Sarychev layer with time. Do you see changes also in one or more of the other properties?

Page 4, line 31: At this point ' $\eta$ ' is not defined. Please make sure that all variables are defined when using them the first time.

Section 3.1: How is the BTD algorithm defined? Please give more information about this.

Section 3.1: Why do the conditions differ for the different volcanic layers?

Section 3.2: What is meant by the 'mean scattering ratio'?

Section 4.2: Mean color ratio for Sarychev layer does not agree with value given in Table 2.

Section 4.2: In the Abstract it was reported that the depolarization ratio exponentially decreased with time. This is not reported in Section 4.2. As the change in the optical properties is an important point and thus reported in the Abstract it should also be referred to in the description of the Sarychev layer. How do the other optical properties behave? What are the properties in the beginning of the observations (, mid) and end? This is reported quite lately in the manuscript. To which periods does the mean value correspond to? If the mean values are calculated from the whole period what is the significance of this mean value?

Section 4.3: How is a valid lidar ratio profile defined (time/length)? The number of cases/profiles resulting into the mean values should also be given for the other cases. Information about the CALIOP measurements (number, time, days, and lo-

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cation) should be given for the different cases should.

Section 4.3: Standard deviation of color ratio does not agree with the value given in Table 2.

Section 5.1: What is meant by the aerosol scattering ratio?

Section 5.3: Why did you use the error calculation according to Equation 9? This formula is used for the calculation of random (statistical) errors. To my understanding, the errors considered in this manuscript are not random errors and thus the total error should be calculated from the absolute error values of the considered parameters.

Figures 5-7: Please indicate the aerosol free regions below and above the volcanic layer.

Section 6.1: The mean values of the lidar ratio for the Kasatochi and Sarychev layers shown in this case studies are smaller than the mean values reported for the whole measurements for these layers. Can you give more information about the changes over the time? Maybe give a time series of the lidar ratio for the different volcanic layers to illustrate the changes and / or variability over time. Otherwise the mean values of the case studies or the mean values over all suffer the loss of significance.

Section 6.2: It is right that the measurements of the different volcanic layers correspond to different stages / ages of the volcanic layer. However the way it is described here could lead to misinterpretation of this information, as one could think that the measurements of the three volcanic layers can be related to each other and show an alteration of volcanic aerosol layers during time.

Section 6.2: The increase of the Puyehue ash layer with time is small compared to the uncertainties of the retrieved property, thus the statement derived from this changes is very speculative.

Section 6.3, discussion about high lidar ratios for Puyehue: Should not the loss of the large particles also be reflected in the depolarization ratio? No changes are obvious

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there.

Page 8, lines 7-8: This statement about the volume and the particle depolarization ratio is misleading.

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Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-1173, 2017.

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