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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 #2

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Review of Friberg et al. (2018)

Volcanic eruptions represent one of the largest source of natural variability of our climate system. Thus, the construction of long-term database of stratospheric aerosol optical depth is highly important to constrain global climate models. In this study, Friberg et al. (2018) used the CALIPSO space-born lidar to derive the time evolution of stratospheric AOD between 2005 and 2016. They proposed two new techniques to correct the effect of particle attenuation on retrieved optical parameters (backscatter and extinction) and remove Polar Stratospheric Clouds. After selecting a definition of the tropopause based on Potential Vorticity, they show time series of stratospheric AOD and discuss the influence of several volcanic eruptions. Overall, the paper is interesting, and the technique developed to correct the effect of particle attenuation is relatively

well explained. But there are several points which would need serious considerations before its publication in ACP.

1. Purpose of this work. The purpose of this study is not clear. Do the authors intend to create a new aerosol dataset from the CALIPSO data? If yes, do they have a plan for archiving the data and make them publicly available? If this is the case, is there any established collaboration with the CALIPSO team to work on this dataset or it is an independent endeavor?

2. Lack of validation. This study does not make use of additional datasets to compare/validate the retrieved AOD. Several satellite datasets (e.g. OSIRIS, OMPS) are available and could provide a source of validation data but are not used. What about In situ data from the CARIBIC program such as aerosol size distribution in the Lowermost stratosphere? Why not to use those data to infer lidar ratio using Mie Calculations?

3. Retrieving AOD from CALIPSO. The authors propose an approach to correct the particle attenuation effect which is especially important after a significant volcanic eruption. A major issue with the proposed technique is its dependency to the type of volcanic eruptions. The major assumption of the correction technique is to assume that the Upper Troposphere is clear of volcanic aerosol, but this is not always the case as shown after the Kasatochi eruption. Any techniques applied for this purpose should be independent from volcanoes and therefore could only be achieved by the iterative approach developed in Hostetler et al. (2006). The overall impact on the corrected AOD is relatively small (impact between 4-7 %). The authors never discussed thoughtfully the other sources of uncertainties that could have bigger influences (e.g. calibration of the lidar, lidar ratio conversion factor). For example, they rapidly mentioned that the lidar ratio values of 50sr used to convert backscatter into extinction agree with Prata et al. (2017). This is not correct, Prata et al. (2017) found a mean lidar ratio of 69 sr for the Cordon plume, 66 for Kasatochi and 63 for Sarychev. This would increase the volcanic AOD during volcanically influenced periods by 30-40 %. The lidar ratio assumption is therefore one of the main source of uncertainty for AOD retrieved from

CALIPSO but poorly discussed here.

4. English language. This is an overall issue which could be difficult to address without a native English speaker person. However, the level of English in the paper is relatively poor and would need to be improved. I recommend the co-authors of the paper to take part of this effort to improve the English.

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