Response to Anonymous Referee #2 Comments

Authors provide description of updated version of stratospheric aerosol subtyping algorithm (version 4.5) for CALIOP. They provide very detailed explanation of the reasons to revise the lidar ratios and the lidar ratios, as well as changes in algorithm structure. Updated algorithn is applied to numerous measurement cases, corresponding to ash, smoke and sulfate dominance and results are compared with previous version (V 4.2), demonstrating the difference. The manuscript is well and clearly written, thus is suitable for publishing in AMT. The results presented will be useful for scientific community studying the stratospheric aerosol.

Referee #1 provided detailed comments on manuscript and I have not much to add. But I am confused with choice of lidar ratio for smoke at 1064 nm (Table 2). The value of 30 sr that they suggest is very low by my opinion. There are several publication of Leipzig group

Depolarization and lidar ratios at 355, 532, and 1064 nm and microphysical properties of aged tropospheric and stratospheric Canadian wildfire smoke, Moritz Haarig, Albert Ansmann, Holger Baars, Cristofer Jimenez, Igor Veselovskii, Ronny Engelmann, and Dietrich Althausen, Atmos. Chem. Phys., 18, 11847–11861, https://doi.org/10.5194/acp-18-11847-2018, 2018

The lidar ratios there are 40–45 sr (355 nm), 65–80 sr (532 nm), and 80–95 sr (1064 nm) for Canadian smoke….

Australian wildfire smoke in the stratosphere: the decay phase in 2020/2021 and impact on ozone depletion, Kevin Ohneiser, Albert Ansmann, Bernd Kaifler, Alexandra Chudnovsky, Boris Barja, Daniel A. Knopf, Natalie Kaifler, Holger Baars, Patric Seifert, Diego Villanueva, Cristofer Jimenez, Martin Radenz, Ronny Engelmann, Igor Veselovskii, and Félix Zamorano, Atmos. Chem. Phys., 22, 7417–7442, https://doi.org/10.5194/acp-22-7417-2022, 2022

Combined lidar–photometer retrievals revealed typical smoke extinction-to-backscatter ratios of 69 ± 19 sr (at 355 nm), 91 ± 17 sr (at 532 nm), and 120 ± 22 sr (at 1064 nm) for Australian smoke.

I think this difference should be commented.

Thank you for your review and for your suggestion about the choice of lidar ratio for smoke at 1064 nm. We added the following paragraph to Sect. 4.5 to address these observations.

"Recent ground-based lidar and lidar-photometer retrievals of smoke arising from pyroCb events have measured higher 1064 nm lidar ratios than the default value used by CALIOP (30 sr), with values ranging from 80 – 120 sr (Haarig et al., 2018; Ohneiser et al., 2022). The 1064 nm lidar ratio used for all smoke layers in V4.2, and carried forward into V4.5, is based on AERONET retrievals of tropospheric smoke (Sayer et al., 2014). Microphysical differences likely exist between smoke injected into the stratosphere from pyroCb events and smoke residing in the troposphere from more docile events, so lidar ratio differences are plausible. We plan to reevaluate 1064 nm lidar ratios for stratospheric smoke and ash in a future data release."

Note from the authors on additional changes to the manuscript

- The release date for the V4.5 level 2 data products has changed from 2022 to early 2023. This is now reflected in Sect. 2 and in the Data Availability section.
- We changed the notation for attenuated scattering ratio, discussed in Sect. 2, from R_{mas} to R'. The previous notation was used for consistency with that of Omar et al., 2009. However, we find the R' notation is clearer because the prime indicates it is an attenuated quantity, the consequences of which are now discussed in the section. Further, R' is a common notation for attenuated scattering ratio within the lidar community and is used throughout CALIOP algorithm theoretical basis documents.