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Interactive comment on "Evaluation of a Method for Converting SAGE Extinction Coefficients to Backscatter Coefficient for Intercomparison with LIDAR Observations" *by* Travis N. Knepp et al.

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We would like to thank Dr. Bingen for providing feedback on this manuscript. Our responses are provided below (red) to her suggestions (black).

Estimating the PSD from Mie calculation based on assumptions of composition (75%-25%), particle shape (spherical) and size distribution (lognormal), based on a lookup table as explained in ll. 124-133 is a method that has been developed for the case of SAGE II by Bingen et al. (2004). These previous studies are thus an obvious precursor

of the present work and should be duly cited.

Bingen et al. 2004 is not a direct precursor to this study since they used SAGE extinctions and Mie theory to derive particle size distribution (PSD) parameters, while we use Mie theory to form a bridge between extinction and backscatter without attempting to retrieve PSD parameters. Therefore, we do not believe citing Bingen et al. 2004 is appropriate at this specific point in the text. However, we have updated the introduction to add clarification, which includes adding Bingen et al. 2004 as a reference.

Furthermore, it is surprising that the authors claim that the SAGE derived backscatter coefficient "will be independent of wavelength combination", since "it can be trivially demonstrated that, working strictly within the confines of theory, this is the case" (ll 166-167). What the authors mean here is not clear. On the contrary, it is known that Mie theory is valid for spherical particles with a size in the same order of magnitude as the wavelength. In this respect, using wavelengths of 385 of 1020 nm (as in Eq. (4)) is not equivalent at all, the extinction coefficient at the different wavelengths being particularly sensitive to different size ranges (Bingen et al., 2002), and possibly, to different modes present in the aerosol population. Hence, using a wavelength as close as possible to the lidar wavelength (355 nm) in Eq. (4) should be the best choice to provide a coherent conversion of the extinction measurements to an estimate of the backscatter coefficient.

This statement was perhaps poorly worded. We have updated to the text for clarification. What we intended to claim was that under ideal conditions the selection of extinction wavelength combination would have no impact on the derived backscatter coefficient (within the error limits) and that when dealing with theoretical data (which has no errors or uncertainties) this is easily demonstrated. However, we go on to state that the SAGE dataset does have error sources, meaning wavelength selection *might* be important. We devoted the entirety of §3.1 to evaluating the impact of wavelength selection on the calculated backscatter.

Also, the authors do not validate of their estimate of the lidar ratio, although several studies provide comparisons data. For instance, Vernier et al. (2011) derived a climatology of extinction-to-backscatter ratio based on GOMOS and CALIPSO measurements at 525 nm. Also, Bingen et al. (2017) present an intercomparison between GOMOS aerosol extinction coefficient and lidar measurements from several ground-based stations including Mauna Loa, and discuss the results of these intercomparisons as a function of the choice of extinction-to-backscatter ratio. Finally, Painemal et al. (2019) published lidar ratios above oceans retrieved from CALIPSO and CloudSat. These results would be usefully compared to the results of the present study to assess the robustness of lidar ratio estimates from these satellite measurements.

The discussion regarding lidar ratio agreement to other measurements has been updated and the reference list augmented.