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Atmospheric Measurement Techniques Discussions

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.

Anonymous Referee #3

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General comments on Knepp et al. [2020]:

This paper presents a novel way to compare the "native" products of two types of stratospheric aerosol data: The extinction coefficients derived from SAGE measurements and the backscattering coefficients derived from LIDAR measurements. The method is carefully evaluated based on the statistical properties of the SAGE data product, and the paper provides clear guidance for the reader who is interested in applying the method.

Detailed comments:

Line 24: "This technique allows for high-precision measurements on the order of 5%

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for aerosol extinction. . .” – This statement requires attribution.

Line 123: Assuming that the PSD is single-mode log-normal definitely reduces the problem to a manageable solution space, but was any analysis done to estimate how your conclusions might change if you assumed some other model? In particular, in-situ stratospheric aerosol observations (see http://www.atmosp.physics.utoronto.ca/SPARC/index.html, for example) frequently show multiple modes, and the different particle sizes represented in those modes clearly have the potential to affect the extinction and phase function differently.

Line 127: The symbol r_m is frequently called the “mode radius” in the aerosol literature, but it actually represents the median of the distribution (See Johnson, Norman L.; Kotz, Samuel; Balakrishnan, N. (1994), "14: Lognormal Distributions", Continuous univariate distributions. Vol. 1, Wiley Series in Probability and Mathematical Statistics: Applied Probability and Statistics (2nd ed.), New York: John Wiley Sons.)

Line 129: “. . . a new log-normal distribution as r_m took on each value within r.” Is this accurate? If so, then you considered distributions for which r_m occurred at the smallest (and largest) possible particle size? This seems ill-advised from a mathematical perspective (& doesn’t really yield a “log-normal” distribution in any meaningful sense). Your solutions lie comfortably in the middle of the range given, so this is probably a minor point, but perhaps the description should be re-written?

Line 159: Were any comparisons made between the derived beta_355 and the SAGE measurement of aerosol extinction at 385 nm? That SAGE product is generally understood to be lower in quality than the aerosol extinction at longer wavelengths, but it is a bit strange not to use it, or even mention its existence as an option.

Figure 2 is a bit blurry.

Figure 3: I’m not sure that I understand the meaning of the dark red vs. light red vs. gray regions.

Line 280 – This “atmospheric opacity and cloud contamination” concerns here clearly correspond to SAGE measurements, correct?

Line 323 – Is there a reference for the details of the “new lidar instrument setup” mentioned here? It might provide helpful context for the sudden change observed in the comparison.

Line 337 – “Smoke from the pyroCB was visible over OHP, but not over Mauna Loa.” This seems reasonable, but what evidence is it based on?

Line 342 – “precision/accuracy . . . is too limited to make meaningful measurements during background conditions.” This is an alarming statement on its face, but I assume you only mean to exclude the possibility of meaningful measurements of the beta_355 parameter under discussion.

Technical comments:

General - The units of the lidar ratio (S) should be presented consistently (sometimes it has no units, sometimes sr).

Line 88 – “Bakckscatter”

Line 278 / Equation 5 – Lidar should be subscripted in denominator

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