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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol extinction to backscatter ratio derived from passive satellite measurements" *by* F.-M. Bréon

Anonymous Referee #1

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This article presents a method of retrieving aerosol lidar ratios from extinction retrievals and reflectance measurements obtained by the POLDER instrument. This is a potentially valuable contribution, as it enables a gridded climatology of lidar ratios over oceans that could potentially be used to assist the CALIPSO aerosol optical depth retrievals. Unfortunately, details are lacking in this paper, so it is difficult for the reader to have confidence in the results. Also, the authors used a mathematical approximation (in their Eq 1) that is not appropriate for this application, in my opinion.

Major Issues
My main problem with this article is that the authors do not attempt to assess the accuracy of their lidar ratios or their phase function derivatives (i.e., their 'V' values of Eq 4).

Their retrieval begins with Equation 1, which includes an approximation that requires the exponential term to be much less than 1. That is, the authors are using the approximation $\exp(-x) \approx 1 - x$ when $x \ll 1$, although they do not state this (they should have!). The error associated with the "small x" approximation is $\leq$10% at $x \leq 0.4$, but it rapidly increases to 47% at $x = 0.75$.

Now, the view zenith angle for POLDER at an aerosol scattering angle of 180 degrees is equal to the solar zenith angle (authors state this on page 3), so the exponential term in Eq. 1 is $x = 2\tau/\mu_s$. Thus, we require $2\tau/\mu_s \leq 0.4$ in order to maintain 10% accuracy in the approximation of Eq 1, or $\tau \leq 0.2 \times \mu_s$. The corresponding maximum optical depths for ≤ 10% error for 3 SZAs are shown in the table below:

SZA	τ_{max}
0	0.2
45	0.14
70	0.07

Note that the maximum allowed τ is 0.2 at high sun (SZA = 0), and decreases with increasing SZA. On page 6 the authors state that they limit their retrievals to $0.1 \leq \tau \leq 0.4$, but their restriction needs to be much more stringent. Indeed, $x = 0.8$ when $\tau = 0.4$ at SZA = 0, and the "small x" approximation results in an error of 55% wrt the exact equation. The errors rapidly get much worse at non-nadir SZAs. This is a major problem, because the authors use the approximation in Eq 1 to "correct" the scattering phase function. Thus, the authors need to present an extensive discussion of the errors associated with this approximation, and argue why they believe that this is a valid approach. In my opinion, the authors should not bother using this approximation (it is also possible that this approximation is causing some of the zonal gradients that they mention on page 8).

The other problem is that there are no statistics and no sensitivity studies in this paper.

The authors present seasonal maps, but the reader does not have any idea of how many points are included in each region (other than the white regions, which contain no valid retrievals). The authors to state in page 9 that “the number of valid observations is relatively small compared to. . . ," but what is that small value? The reader only knows that colors in the maps have 1 or more data points, but that is not enough information.

Minor Issues

There are many cases where the authors use ‘BER’ when they mean ‘EBR’.

Eliminate the adjective ‘so-called’ throughout the article, as it has no real meaning or value.

Replace “bi-dimensional" with “two-dimensional."

Page 3: The nomenclature “independent sensitive areas" is a bit odd...

Page 4: The authors state that the aerosol inversion procedure uses a set of bimodal aerosol models, but they do not tell the reader how many models are used. Since aerosol optical depth is such an important component of the EBR, the authors should provide a brief overview of the POLDER retrieval procedure, and the corresponding errors.

Page 3: The authors talk about snapshots every 20 seconds, and mention “a large overlap between snapshots." Yet on page 8 they state that the observations are separated by “≈140 km (the distance travelled by the satellite during the 20 seconds). Why the inconsistency?

Page 5: Are the authors using the POLDER extinctions, or computing their own values? This needs to be stated. What is the effect of using a "corrected" phase function with an uncorrected extinction?

Page 5: The authors discuss using measurement sequences that encompass the backscattering geometry to determine "V," and state that the time difference is ≈ 20 sec, but what is the typical difference in angles?

Page 5: Burton et al. reported on High Spectral Resolution Lidar (HSRL) measurements, not Raman lidar measurements.

Page 8, last paragraph: I found this confusing: “Let us recall that the POLDER measurement principle is that of a very wide field of view that acquires one shot for each spectral band every ≈20 second. For each such acquisition, there is one point on Earth that is observed in the backscatter direction." This sounds like backscatter sampling should occur every 20 seconds, but the authors go on to say that they only obtain 1 sample per orbit. Some clarification would be helpful, here.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 2351, 2013.