Review on

Depolarization Ratios Retrieved by AERONET Sun/Sky Radiometer Data and Comparison to Depolarization Ratios Measured With Lidar

by *Noh et al.*

ACPD 2016-1181

General comments

This article addresses a problem of dust particles detection in the atmosphere, which is of high interest of scientific community. A new method for quantitative estimation of dust presence based on particle depolarization ratio retrieved from AERONET inversion is suggested. Authors made significant efforts to evaluate the AERONET retrieved particles depolarization ratio by comparing them with ones measured with lidar. To do so a vertical profile of particle depolarization ratio retrieved from lidar measurements is column-integrated using a weighting function. To my knowledge this work shows one of the few positive results of such comparison. I would recommend this paper for publication, given that authors will address the issues listed below.

Specific comments
1. The general idea of evaluating depolarization ratio retrieved from AERONET by comparison with lidar retrieved values implies that lidar retrievals are well evaluated. I think that such implication is not properly supported in the paper.
2. The depolarization ratio defined from AERONET retrievals by eq. 1 has a meaning of $\frac{\beta_{p,\perp}}{\beta_{p,\parallel}}$. Justification needed why this parameter is compared with one retrieved from lidar (eq. 4), which is not the same physical value.
3. **Page 11. Line 217.** Molecular depolarization ratio is system dependent it is not clear if the value 0.0044 provided by Behrendt and Nakamura suits the lidar system used.
4. **Page 11. Formula 7.** From the description it is not clear how aerosol backscatter coefficient is "measured".
Was Raman or Klett technique used?
If Klett, which lidar ratio was assumed?
If Raman, which angstrom was used?
Do these values suit dust particles? Also it is not clear how their selection influences the column-integrated depolarization ratio estimated from lidar, if any of the methods was applied.

Technical issues
Page 2. Line 42-43. "Decreases with increasing" and "In contrast … increases with decreasing" describe the same situation. Should be "increases with increasing", I presume.
Page 3. Line 67. "global atmosphere", I think simple "atmosphere" would be enough.

Page 4. Line 76. "desert dust and other anthropogenic …". Usage of "other" implies that dust I s also anthropogenic, consider removing it.

Page 4. Line 78 & 80. "typical radius" instead of "typically".

Page 4. Line 83. "we'll" instead of "we" for conditional clause.

Page 4. Line 90. Space is missing in "lidar.The"

Page 14. Lines 296–299. "Values of …from both instruments". It is not clear that authors are discussing results of Muller et al 2012.

Page 17. Description of figure 7. Figure 7 shows AERONET results and it is not indicated neither in the figure description in the text neither in the figure caption.

Page 18. Line 368-369. Whole sentence "Dust particles are…" has no logical connection with the main paragraph describing optical properties of desert dust, consider removing.

Page 18. Line 382-383. "Except for SSA at 440 nm …" and "at each wavelength" in the same sentence are in logical contradiction. Consider reformulating or deleting "each wavelength".

Page 20. Line 427. Description of the table containing abbreviations, and some of them (CMF) are not referenced earlier in the text. Please, indicate the meanings of symbols.

Page 21. Line 447. "and/or a higher" change to "and/or by a higher"

Page 22. Line 474. "…by the mixing of pollution …", maybe "… by the presence of pollution …" instead.

Page 27. Line 576. "The average .. decreases as .. increases ". This phrase is too general. It is true for the values of Rvs and particle type discussed in the text, but generally the dependence is not monotonous. Consider reformulating.

Figure 3. AERONET does provide AOD at 500nm, but it is not "measured", it is "estimated" (or "retrieved") from measurements at 440, 670, 870 and 1020nm.

Figure 6. Is it possible to make plots bigger? And since the plots are referenced by the number of the group, maybe, it'll be more logical to name plots 1a, 1b, 1c … 6a, 6b, 6c rather than a1, a2, a3, …. f1, f2, f3.

Figure 7. Please, mention in caption that SSA and SD are from AERONET.

Figure 9&11 Why only these figures have error bars? They are not discussed or mentioned in the text, are they necessary?

Figure 12. Please, put legend "case 1" and "case 2" on the plots.