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Atmospheric Measurement Techniques Discussions

Interactive comment on "Experimental assessment of the lidar polarizing sensitivity" *by* L. Belegante et al.

Anonymous Referee #1

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The depolarization ratio is an important property to characterize different aerosol types. An exact measurement of this quantity is therefore an important issue. The manuscript describes a method to assess and to correct for the diattenuation of receiving optics and the rotation angle between the laser and the receiver. It is shown that these corrections lead to a significantly better result for the volume depolarization ratio (fig 9). The lidar community will profit from these techniques. Therefore I recommend it for publication, although there are some mayor points that have to be improved:

Firstly I dare that the figures do not fulfill the standard of the journal. A professional plot program should be used.

Secondly There is no clear hint, that the shown 6 example cases are corrected with all the effort described in this paper. The diattenuation of the receiving optics (D0) is

given for 4 out of 6 lidar systems; the laser rotation alpha is given for the Bucharest system only. If you assess experimentally the lidar polarization sensitivity you have to do it for every system that you are presenting in the paper. It is an AMT publication and you use 6 out of 14 figures just to give examples for different atmospheric conditions without showing the improvement due to your correction scheme or assessing the polarization sensitivity. It is already known that exact depolarization measurements are important, so please do not show only the measurements, but the improvement due to your corrections (with and without calibration).

Thirdly For all figures (fig 4,5,6), if alpha does not exceed 10-15° in real situations (as you say), figures have to be limited to this range. You may show the whole range at the beginning (fig 4a), but later on, only real situations are of interest for the reader and not the theoretical maxima and minima of your simulation. You lose a lot of relevant information by using these large scales.

I strongly recommend improving these 3 points before publishing the manuscript.

The following comments should be considered and answered before publication. They are meant to improve the quality of the paper and consider related aspects.

Comments: (p-page; l-line; eq-equation)

p4 l19-22 How do you separate the influence of the angle α and a possible circular component resulting in elliptical polarized emitted light?

p5 l16 2 lidar systems without emitter optics out of 6 investigated systems is no reason to neglect this part.

You should include setup c (total and cross) in your paper in order to describe the different depolarization setups. Add comments on setup c in eq 17 and 18. The manuscript seems incomplete in this point.

p9/10 It would be helpful to add a sketch to explain your estimation of the calibration error ε. Please check (p9 l22) K $\leq$ (1-a); for aerosol free region (a=1), K would be

≤ 0. From eq 29 to eq 30 it is a simple transformation, which would imply $\varepsilon 2 = \varepsilon/\varepsilon 1$. But how do you define your $\varepsilon 2$? And p10 l6 is η really dependent on the atmospheric depolarization or should it be η*?

The wavelength dependence of several parameters and calibration methods should be mentioned.

The simulations are a central part of the paper, assessing the sensitivity of different parameters. A description of the simulation and all the values used for the Bucharest lidar system are missing.

Minor/Technical comments:

p2 l16 “recent atmospheric studies” -> Citation

p2 l32 “uncertainty”: the before mentioned values vary due to natural variability and uncertainties are not yet mentioned

p3 l16 in the introduction it is not necessary to mention “(α)”

p5 eq 6 φ is not explained

p7 eq 15 It should be mentioned that y=$\pm$1, otherwise the transformation is not correct. It would be nice to include this information (y=$\pm$1) in figure 2, too.

p8 l28 “depolarization analyzer” or polarization analyzer?

p9 l10/11 “According to ... PBS, PMT).” This sentence is valid for every calibration method, not only for the linear polarizer.

p12l4 “polarization Raman lidar” not “depolarization Raman lidar”

Fig 4, very interesting results, but to emphasis the message, split fig 4b for high and low depolarization ratios or use a logarithmic scale, otherwise your threshold of 3° seems somehow arbitrary. You say (p13l27/28) that alpha will not exceed 10-15°, so fig 4c should be plotted only till 20° not 50°. p13l27 “the dependence between the retrieved

calibrated signal ratio and alpha is more significant” please include relative errors in the text to demonstrate this. Small comments: figure description 4b is plotted (0°:10°) Why do you use 0.4 in figure 4c and 0.35 in fig 4a and 4b?

eq 35 after removing the polarizer, there should be no η_polˆ*

p15, chap 3.4.3, a suggestion: add a sub headline “Analytical correction” analogous to “Correction of alpha in front of the PBS”

fig 6a+6b is identically to fig 4a+4b; δˆ* (α) in exactly the same range is shown.

p17l4-7 To derive the diattenuation of the receiving optics it is not necessary to have 2 different calibration methods (pol and rot), but to have 2 different places in the optical setup. To determine D0 it is necessary to calibrate before and after M0. So I would suggest calling it “before” and “after” instead of “pol” and “rot”.

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