

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

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Short Comment on the manuscript by L. Belegante et al. on “Experimental assessment of the lidar polarizing sensitivity”

Let me please thank the AMT-journal for giving me the opportunity to participate to the open discussion on the manuscript proposed by Belegante et al.. This manuscript deals with the important concern of performing accurate polarization lidar measurements. I have several questions on this manuscript, which I hope may benefit to the authors and to potential readers. My comments are in line with the 2nd reviewer and I here bring additional details on what this reviewer states in his report. I also bring a few additional questions.

1. In their manuscript, Belegante et al. discuss on the influence of the lidar optics on

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depolarization products and on the effect of the rotation of the plane of polarization of the laser with respect to the PBS. In 2012, I published a paper (G. David et al., Appl. Phys B, 108, 197-216, 2012) which was precisely addressing the same issues through laboratory and field experiments. Could the authors situate their work in regards to other published works and specifically identify what is here new? I feel quite surprised that this paper is not even quoted.

2. In Section 2, the authors use the Stokes-Mueller matrix formalism in a lidar measurement. The Mueller matrix of the emitter optics is there introduced. I introduced how to use the Stokes-Mueller matrix formalism with a pulsed laser source in the specific lidar backscattering geometry in (G. David et al., Opt. Exp., 21, 16, 18624-18639, 2013). There, with my co-authors, we introduced the Mueller matrix of the emitter optics, as it is done here. Could the authors situate their work in regards to this published work? I feel quite surprised, especially in a high ranking journal as AMT.

3. At page 3, the authors speak about “new techniques for performing the calibration of lidar depolarization channels”. Could the authors precisely indicate what is intended by new calibration techniques? Moreover, the calibration procedure at  $\pm 45^\circ$ , which relies on only two points, does not appear, according to the literature, as the most accurate one. Indeed, following Alvarez et al., JTECH, 23, 2006 (from Winker’s group, a paper that is quoted) or our paper (G. David et al. 2012), an accurate calibration can be achieved by studying the evolution of the measured depolarization as a function of the angle between the transmitter and the receiver axes. This calibration procedure leads to more accuracy as it relies on several points (around 12), instead of two points as performed in the  $\pm 45^\circ$  procedure. Even the offset angle can in this way be corrected for, as discussed by Alvarez et al.. We extended his methodology to the case where the HWP is inserted at the emitter in David et al. 2012. Moreover, when using their  $\pm 45^\circ$  procedure, the authors have to account for possible saturation of the detector. How is it done here? This sounds as a very important issue so as to be quantitative. What is the final assessment of the accuracy of your measurements?

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4. As a reader, I found the manuscript very long. Could it be reduced and focused on what is here new ? It would help potential readers.

5. What do the authors intend by “polarizing sensitivity “ as proposed in the title of the manuscript? As well-known, the question of sensitivity can be very different from that of accuracy. To perform a sensitivity study, depolarizations less than the percent range should be addressed, as we discussed in G. David et al., in 2012.

6. Many lidar stations are nowadays equipped with dual-wavelength capabilities. How do you account for the influence of wavelength-dependent optics in your study ? What are the wavelength cross-talks and their influence on the polarization retrievals? This issue sounds important in a manuscript where the authors deal with “correcting the influence of the receiver optics”. I recall that a prerequisite to the polarization lidar calibration is that the detector transfer matrix be diagonal with negligible wavelength and polarization cross-talks, as we published (David et al. 2012). If not, this may lead to quite substantial errors in the measured depolarization ratio.

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