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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Polar stratospheric cloud climatology based on CALIPSO spaceborne lidar measurements from 2006–2017" *by* Michael C. Pitts et al.

Anonymous Referee #1

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On page 5 the authosr state that

$$R_{532} = \frac{\beta^{\parallel}_{\text{par}} + \beta^{\perp}_{\text{par}}}{\beta_{\text{mol}}} \,. \tag{1}$$

However the general definition of the backscatter ratio is

$$R = \frac{\beta}{\beta_{\text{mol}}} = \frac{\beta_{\text{par}} + \beta_{\text{mol}}}{\beta_{\text{mol}}} \,, \tag{2}$$

If backscattered light is measured in separate channels for the detection of light that is polarized parallel and perpendicular with respect to the plane of polarization of the

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Discussion paper

emitted linearly polarized laser light, the definition of β changes to

$$\beta_{\mathrm{T}} = \beta_{\mathrm{par}}^{\parallel} + \beta_{\mathrm{par}}^{\perp} + \beta_{\mathrm{mol}}^{\parallel} + \beta_{\mathrm{mol}}^{\perp} \,. \tag{3}$$

Now $\beta_{\mathrm{par}}^{\parallel}$ and $\beta_{\mathrm{par}}^{\perp}$ represent the co- and cross-polarized backscatter coefficient, respectively.

Combining eqs. (2) and (3) leads to the total backscatter ratio for polarization-sensitive measurements

$$R_{\mathrm{T}} = \frac{\beta_{\mathrm{par}}^{\parallel} + \beta_{\mathrm{par}}^{\perp} + \beta_{\mathrm{mol}}^{\parallel} + \beta_{\mathrm{mol}}^{\perp}}{\beta_{\mathrm{mol}}^{\parallel} + \beta_{\mathrm{mol}}^{\perp}} \,. \tag{4}$$

The backscatter ratio can also be calculated individually from the measurements in the polarized channels as

$$R^{\parallel} = \frac{\beta_{\mathrm{par}}^{\parallel} + \beta_{\mathrm{mol}}^{\parallel}}{\beta_{\mathrm{mol}}^{\parallel}} \tag{5}$$

and

$$R^{\perp} = \frac{\beta_{\mathrm{par}}^{\perp} + \beta_{\mathrm{mol}}^{\perp}}{\beta_{\mathrm{mol}}^{\perp}} \,. \tag{6}$$

It is not clear if this is an error in writing the manuscript (i.e. notation) or if the calculations have been performed with an incorrectly calculated backscatter ratio. Your use of the attenuated backscatter coefficient, which is defined as

$$\beta_{532}^{\prime\parallel} = \beta_{532}^{\prime\parallel} + T_{532}^2 \,, \beta_{532}^{\prime\perp} = \beta_{532}^{\prime\perp} + T_{532}^2 \tag{7}$$

in the CALIPSO ATBDs cannot explain the difference.

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