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 authors state that

\[ R_{532} = \frac{\beta_{\parallel par} + \beta_{\perp par}}{\beta_{mol}}. \]  

(1)

However the general definition of the backscatter ratio is

\[ R = \frac{\beta}{\beta_{mol}} = \frac{\beta_{\parallel par} + \beta_{mol}}{\beta_{mol}}, \]  

(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 C1 emitted linearly polarized laser light, the definition of \( \beta \) changes to

\[ \beta_T = \beta_{\parallel par} + \beta_{\perp par} + \beta_{\parallel mol} + \beta_{\perp mol}. \]  

(3)

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

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

\[ R_T = \frac{\beta_{\parallel par} + \beta_{\perp par} + \beta_{\parallel mol} + \beta_{\perp mol}}{\beta_{mol} + \beta_{mol}}. \]  

(4)

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

\[ R_{\parallel} = \frac{\beta_{\parallel par}}{\beta_{mol}} \]  

and

\[ R_{\perp} = \frac{\beta_{\perp par}}{\beta_{mol}}. \]  

(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

\[ \beta_{\parallel} = \beta_{\parallel 532} + T_{\parallel 532}, \beta_{\perp} = \beta_{\perp 532} + T_{\perp 532} \]  

in the CALIPSO ATBDs cannot explain the difference.