Response to Reviewer # 1

Thanks very much for carefully reading the manuscript and for the useful suggestions. We list below the changes we have made in the manuscript in response to your comments.

1) ***As indicated in the very first lines of the manuscript, in the abstract, the author's intention in this work is to provide the motivation of the new algorithm implementation for CALIPSO 4.1 calibration. The motivation is highly related with the problems identified due to the V3 normalization altitude between 30 and 34 km, which led to the idea of the new normalization altitude between 36 and 39 km. Therefore I would expect a more extended literature survey studies related to CALIPSO validation. In this way the motivation of the new algorithm would be more clearly introduced in the beginning of the manuscript, for the entire study to follow presenting how the problems-biases were dealt with.***

We have added the following text in the section 2.1 describing the motivation for the new calibration:

"Given the degree of accuracy desired, validation of the CALIOP level 1 data has always been a challenging task. Beginning early in the CALIPSO mission, extensive efforts were expended to use the European Aerosol Research Lidar Network (EARLINET) of ground based lidars to evaluate the CALIOP level 1 data. Using the coincident measurements (within 100 km and 2 hours) from the Raman lidars operating at these stations and making use of the extinction profiles from these upward looking Raman lidars, a CALIPSO like attenuated backscatter profile was constructed which was then compared with the corresponding CALIOP attenuated backscatter profiles. Using this strategy, several studies found a general underestimate in the CALIOP attenuated backscatter values in the free troposphere under clear sky conditions (Mona et al., 2009, Mamouri et al., 2009, Pappalardo et al., 2010). While these studies pointed towards a possible issue with CALIOP calibration, there are significant issues involved in using ground-based lidars to validate satellite lidars, especially with regards to spatial and temporal matching. Gimmestad et al. (2017) pointed out that an inherent difficulty in validating CALIOP observations is the need to average over large distances along-track to sufficiently reduce the random noise in the CALIOP measurements. A more rigorous evaluation of the CALIOP calibration was possible using airborne LaRC HSRL underflights beginning early in the CALIPSO mission, using internally calibrated data from the HSRL 532 nm channel. From the early HSRL campaigns, P09 reported an underestimate of ~5% in the mean nighttime calibration and attributed this bias to the presence of stratospheric aerosols in the calibration region. Using data from many more underflights, Rogers et al. (2011) found an underestimate of the total attenuated backscatter measured by CALIOP of 2.7% ± 2.1% for nighttime data."

2) ***Signal-to-Noise ratio and Noise-to-Signal ratio. Both are used, sometime in the same sentence. In the first part of the manuscript, the "Signal-to-Noise" ratio is presented and discussed, while in the second half the ratio is switched to "Noise-to-Signal", not only in the manuscript but also in the figures and the discussion. I suggest the authors to keep one throughout the entire manuscript.***

As mentioned in the paper, we have followed the calibration methodology developed in Powell et al. (2009) who used both these quantities. In particular the noise-to-signal ratio was found to be effective in analyzing the impact of the high energy transients and their removal. So we have retained both these terms in the current manuscript. As such Noise-to-signal ratio has been clearly defined in the text.

3) ***Page 5, lines 8,9 and for Figure 2: For GOMOS, the aerosol extinctions at 500 nm were converted to R at 532 nm using a stratospheric aerosol lidar ratio of 50 sr and an Angstrom exponent of 1.5. Why a LR of 50 sr was used and an Angstrom exponent of 1.5? Please provide related reference. Furthermore the justification of selecting SAGE II and not GOMOS as a reference standard is missing. References are needed also.***

We have added the following text:

"A lidar ratio of 50 sr is typically used for quiet non-volcanic ("background") conditions in the stratosphere (e.g., Kremser et al., 2016), while the value of the Angstrom exponent was adopted from the balloon measurements of Jager and Deshler (2002)."

SAGE II has been generally accepted as the standard for stratospheric aerosol measurements and thus we used it as such, rather than GOMOS.

4) ***Figure 7: The rate Îd'he V3 and V4 are characterized indeed by similar PDAC calibration success rates, although V4 seems somewhat more noise. I suggest the authors to include along with Fig.7a and Fig.7b a third figure showing the Relative (or Absolute) Difference between the two (V3 and V4) in order for the features of the changes in the success rate to be shown more clearly***.

We have added the figure (Figure 7c) suggested by you.

5) ***Figure 8: Fig. 8 shows the time series of the granule averaged V4 532 nm CALIOP nighttime channel calibration coefficient. I would suggest the authors to include the similar V3 calibration coefficient (on the same figure), since the paper is highly related to the change from V3 to V4 normalization altitude.***

We have added the plot of V3 calibration coefficient in Figure 8 as suggested by you.

6) ***Validation of V4 calibration: Comparisons with HSRL measurements (Figure 17): I would suggest the use of (CALIOP-HSRL)/HSRL and not the (HSRLCALIOP)/HSRL, hence subtracting the reference (HSRL) from the measurement-tobe-validated (CALIOP). The use of (CALIOP-HSRL)/HSRL would in addition provide consistency with other CALIPSO validating studies (Pappalardo et al., 2009).***

The HSRL validation of CALIOP calibration described in Powell et al. (2009) and Rogers et al. (2011) are crucial references for this work and for easy comparison and continuity it is important to retain the same format used by these authors. Hence we have decided to retain the figure (Figure 17) as it is.

7) ***Reference: Getzewich, B., Vaughan, M., Hunt, W., Avery, M., Tackett, J., Kar, Lee, K.-P.: CALIPSO Lidar Calibration at 532 nm: Version 4 Daytime Algorithm, in preparation, 2017. To be submitted in the present Special Issue?***

Yes, and we have followed the citation format recommended by the AMT editors for the special issue.

8) ***The reference list of related work is highly biased towards US groups. I suggest to consider acknowledging the work of European groups that have devoted time and effort on CALIPSO, including cal/val studies, mostly published on AMT or ACP Copernicus journals.***

We can assure you that there was no deliberate attempt to avoid citing the European works! In any case following your comment #1 we have cited the initial validation works by the EARLINET groups.

Thank you once again and we hope that you would be agreeable to the revisions described above.