Answer to reviewer 1

(5728,10-13) Here, the second mode the authors claim to be apparent in the airborne lidar data histogram is REALLY difficult to discern. Less so is the bimodality in the CR histogram panel. As these different modes in the histograms are so difficult to imagine, and their manifestation or not, does not hamper any of the subsequent analysis, I would suggest to discuss the data simply in term of existences of relatively high left tails of the histograms, attributable to different particle populations, mirrored in the two modes of the CR histograms.

This has been modified to mention that both the IR and the green distribution show a high left tail in the histogram implying that air masses with R532 > 1.4 and R1064 > 2.8 are also frequently found. Furthermore values of aerosol color ratio larger than 0.5 can only be obtained if a significant fraction of aerosol with moderate R532 values near 1.2 contributes also to the high left tail of the R1064 distribution.

In subparagraph 3.2, a review on how the aerosol backscattering at 1064 nm has been calibrated - there's ample literature on similar studies – in the molecular backscattering is too noisy, should be quoted. Moreover, as the CALIOP lidar calibration constant at 1064 nm is operationally evaluated by comparing 1064 and 532 nm signals in high cirrus clouds, some word should be spent on how the recalibration carried out in the present study may change the cirrus color ratios. I aknowledge the fact that the authors make no use of any CALIOP cirrus product, nevertheless I think it is worthwhile to discuss how would the CR behave on cirrus clouds after the proposed recalibration.

We agree that it is a very important question. We have modified section 3.2 and the conclusion addressing two different angles of this question:

1) First to discuss more the fact that a change of the 1064 nm lidar calibration implies an impact on cirrus clouds color ratio selected for the calibration criteria of the Version 3 (V3) Caliop level 1 data set

2) Second to recall that out approach based on the expected aerosol color ratio implies that the 532 nm is unbiased. If it is not really the case as discussed in our analysis of the comparison between the airborne lidar and CALIOP 532 nm scattering ratios in section 3.3 then the proposed correction of 1064 nm signal can be reduced significantly. A 5% error in a 532 nm scattering ratio of 1.1 implies a 40% error on the 1064 nm total attenuated backscatter assuming an aerosol color ratio of 0.5. This is added in section 3.2 which is now entitled "Impact of the 1064 nm calibration on the aerosol color ratio" to reflect the limit of our approach for discussing this calibration.

We did not look at the impact of cirrus color ratio because there are only few of them (11 values with only two for nighttime conditions) for the campaign area and time period. It is added in the paper that our correction based on the expected aerosol color ratio implies a positive bias of 40% i.e. a value higher than the expected 20-30% uncertainty on this calibration. It is also stated that this may be modified if there is a correction of a 5% underestimate of the 532 nm channel. Such an underestimate is possible considering the results of section 3.3 showing a bias of -8% between CALIOP and the airborne lidar. In section 3.3 this bias is attributed to sampling differences but possibly also to the 532 nm calibration uncertainties. The conclusion is also modified to keep open the range of the correction needed for the 1064 nm channel. In a future study it would be useful to conduct the kind of analysis proposed in this paper with the new V4 calibrated backscatter data.

(5736, 18) and successive. As one of the possible causes for the small differences in CALIOP and airborne lidar, could this be the different spatial averaging for the lidar profiles, that would tend to lower the optical parameter values for the more spatially average profile, when patchy (both vertical and horizontal) aerosol are encountered?

We fully agree with this . It is the reason why we tried to estimate how the difference between the airborne and CALIOP R_532 means can be explained by a mismatch in the air mass sampling. For example it is explained if there are more layers with small aerosol load (R532< 1.05) in the CALIOP data set. This may be related to the missing of several aerosol layers when removing CALIOP data below clouds by applying our cloud mask on the CALIOP data set. This is better explained in the new version of the manuscript.

(5738, 24) and (5740,10) I do not understand here what is the role of the CALIOP cloud screening the authors are suggesting in order to explain the decrease of CALIOP high aerosol concentration at low latitudes in the lower troposphere, and in general in the 1.5-4 km range. According to my understanding of the authors' explanations, a cloud screening may affect the computation of the average of the optical parameters only if the "screened" aerosol layers have, on the average, higher backscatter ratios than the "not-screened" ones. I can't see why that should be the case.

We tried to emphasize that the airborne lidar and CALIOP cannot see always the same air masses in regions with mid and upper level clouds. The airborne lidar saw more air masses with significant aerosol content in the altitude range 1.5 to 4 km. This may be related to the specific targeting of the aircraft flights to encounter such layers and also to the fact that many of these layers are observed below 4 km in the frontal zone where overlaying clouds (see supplementary document) make more difficult a detection by the CALIOP overpasses. The wider longitude range chosen for the CALIOP data set does not compensate for this difference in the observed air masses. These explanations were added in the text.

Fig.3 please rescale the axis for CR in order to use the full graph.
We do not understand why the reviewer wants to rescale the y-axis because the authors want to emphasize the variation of the values with error bar less 0.5. The points with large error bars are kept but are not considered as significant as explained in the text. Therefore we keep the figure as it is.

Fig.7 Regression line is quoted in the caption but is missing in the graph.
We agree that a regression line is needed in addition to the contour plot of the correlation frequency if we want to make a comparison with the correlation lines corresponding to the different CRa values. Fig. 7 was modified accordingly.

Answer to reviewer 2 :

When you are talking about R(z) can you show an example of how it was calculated to make it more understandable. Probably to include a table with the general parameters of the lidar will help to make it more understandable as well.

This is described in details in a previous paper discussing aerosol Lagrangian study for a specific day of the campaign. It is said in 2.2.1. Two sentences were added to explain this more clearly at the end of the first paragraph and the beginning of the third paragraph.

Pag.5728, Para.5-10 add here the dates from where to where you are making the division.

This was added in the sentence describing the differences between the two subsets.

Pag.5729, Para.20-25 "high correlation is nevertheless observed between lidar backscatter ratio and aerosol particle concentration, as expected" Give here the percentage of the correlation between both measurements.

The value of the correlation coefficient is 0.55 with a significant percentage (> 0.99). This result is now given in the new version of the text. An even better agreement is expected if we add the time delay between the lidar measurements 150 m below the aircraft and the in-situ measurements by using the vertical velocity.

Pag.5734, "Assessment of the 1064 CALIOP calibration" have to be rewritten, the explanation is somehow confused, please add more details about the effect of the cirrus clouds in the CR after apply the recalibration you are proposed here.

We agree that it is a very important question which was also raised by reviewer 1. We added more explanations about the calibration infrared channel used in the Version 3 CALIOP data which were used in this paper. As explained in the answer to reviewer 1, we have modified section 3.2 and the conclusion addressing two different angles of this question:
1) First to discuss more the fact that a change of the 1064 nm lidar calibration implies an impact on cirrus clouds color ratio selected for the calibration criteria of the Version 3 (V3) Caliop level 1 data set
2) Second to recall that out approach based on the expected aerosol color ratio implies that the 532 nm is unbiased. If it is not really the case as discussed in our analysis of the comparison between the airborne lidar and CALIOP 532 nm scattering ratios in section 3.3 then the proposed correction of 1064 nm signal can be reduced significantly. A 5% error in a 532 nm scattering ratio of 1.1 implies a 40% error on the 1064 nm total attenuated backscatter assuming an aerosol color ratio of 0.5. This is added in section 3.2 which is now entitled "Impact of the 1064 nm calibration on the aerosol color ratio" to reflect the limit of our approach for discussing this calibration.
We did not look at the impact of cirrus color ratio because there are only few of them (11 values with only two for nighttime conditions) for the campaign area and time period. It is added in the paper that our correction based on the expected aerosol color ratio implies a positive bias of 40% i.e. a value higher than the expected 20-30% uncertainty on this calibration. It is also stated that this may be modified if there is a correction of a 5% underestimate of the 532 nm channel. Such an underestimate is possible considering the results of section 3.3 showing a bias of -8% between CALIOP and the airborne lidar. In section 3.3 this bias is attributed to sampling differences but possibly also to the 532 nm calibration uncertainties. The conclusion is also modified to keep open the range of the correction needed for the 1064 nm channel. In a

future study it would be useful to conduct the kind of analysis proposed in this paper with the new V4 calibrated backscatter data.

Pag.5741, Para.10-15 Change "serosol" for aerosol.
done

Pag.5761, Add the Regression line to the figure 7, it is mention in the caption but is not include in the graph.
done

Pag.5763, Fig. 9 Change the scale for the aerosol color ratio LNG, use the same that for CALIOP and how is mention in the text.
Yes we agree it is better to use the same relative unit instead of percentage. The two figures were modified accordingly.