**Response to referee #1**

We would like to thank the referee for her/his constructive remarks. We especially appreciate her/his patience and efforts to point out the grammatical errors and, more importantly, willingness to suggest corrections for them.

We have taken into account almost all issues raised by the referee. Please find below point by point reply to them.

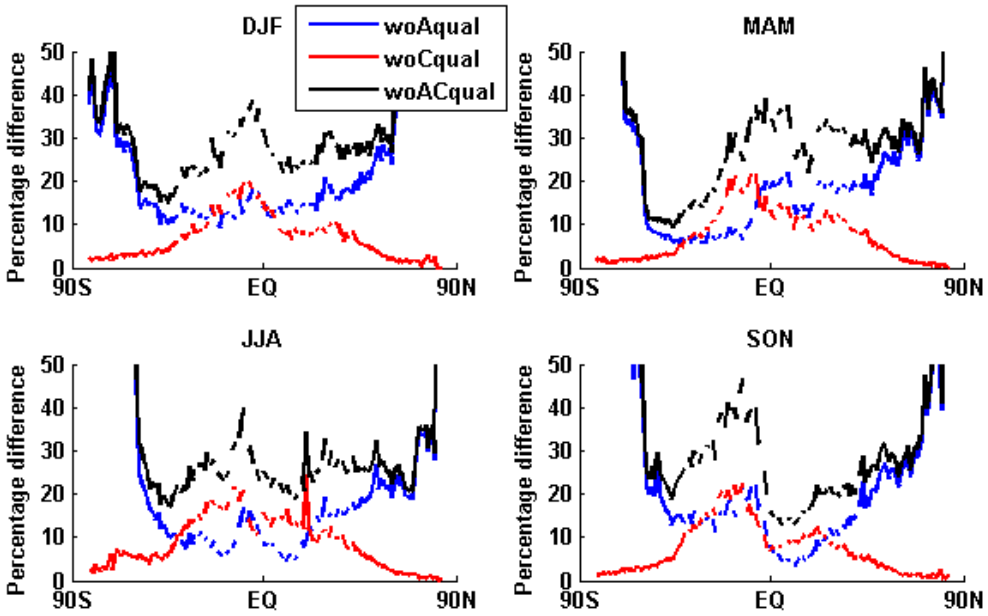
1) We agree with the referee that it is important to investigate sensitivity of overlap frequency estimates to the chosen quality flags. Our motivation to use only the highest quality observations was based on the fact that such observations are most likely to provide accurate and realistic estimates of statistics (albeit on the lowermost side).

Following your suggestion, we have investigated sensitivity of overlap frequency estimates to the aerosol and cloud layer quality flags. The results from this analysis are indeed seemed to be very useful. The following text and figure are now added in the revised manuscript.

Since we used the aerosol and cloud layers detected with the highest confidence for analysis (and thus providing the lowermost estimates of overlap frequency), we further investigated the sensitivity of our estimates to the aerosol and cloud feature detection quality flags. We reprocessed the entire four year data sets when a) the quality flag for the aerosol feature is switched off (denoted by woAqual), b) the quality flag for the cloud feature is switched off (woCqual), and c) the quality flags for both aerosol and cloud features are switched off (woACqual). We then computed the zonal mean percentage differences in overlap frequency in the above three cases with respect to the case when the strictest quality criteria were used.

The results of this sensitivity study are presented in Fig. 5 for the AAO case. In the tropics (30S-30N), the estimates of overlap frequency are constrained by the quality of both aerosol and cloud features, however towards the higher latitudes, these estimates are constrained mainly by the aerosol feature quality flags. The seasonal changes in the zonal structure of the percentage differences for the woAqual case (in Fig. 5) also reflect the seasonal and zonal shifts in peak overlap frequencies in the tropics and the mid-latitudes (in Fig. 3). For example, in the SON months, the estimates of overlap frequencies are roughly 15-20% higher over the 0-50S latitude band for the woAqual case, while in the MAM months, the estimates are higher over the 0-50N latitude band. In general, the sensitivity of overlap frequency to the quality flags varies as a function of latitude and season. When all aerosol and cloud layers are considered for the analysis irrespective of their detection quality (the woACqual case), the percentage increase in overlap frequency can range anywhere between 10-50% over the regions where aerosols are abundant. However for the following analyses, we prefer to use the strictest quality criteria so as to derive the least uncertain statistics. But for analyzing few days of data in the individual

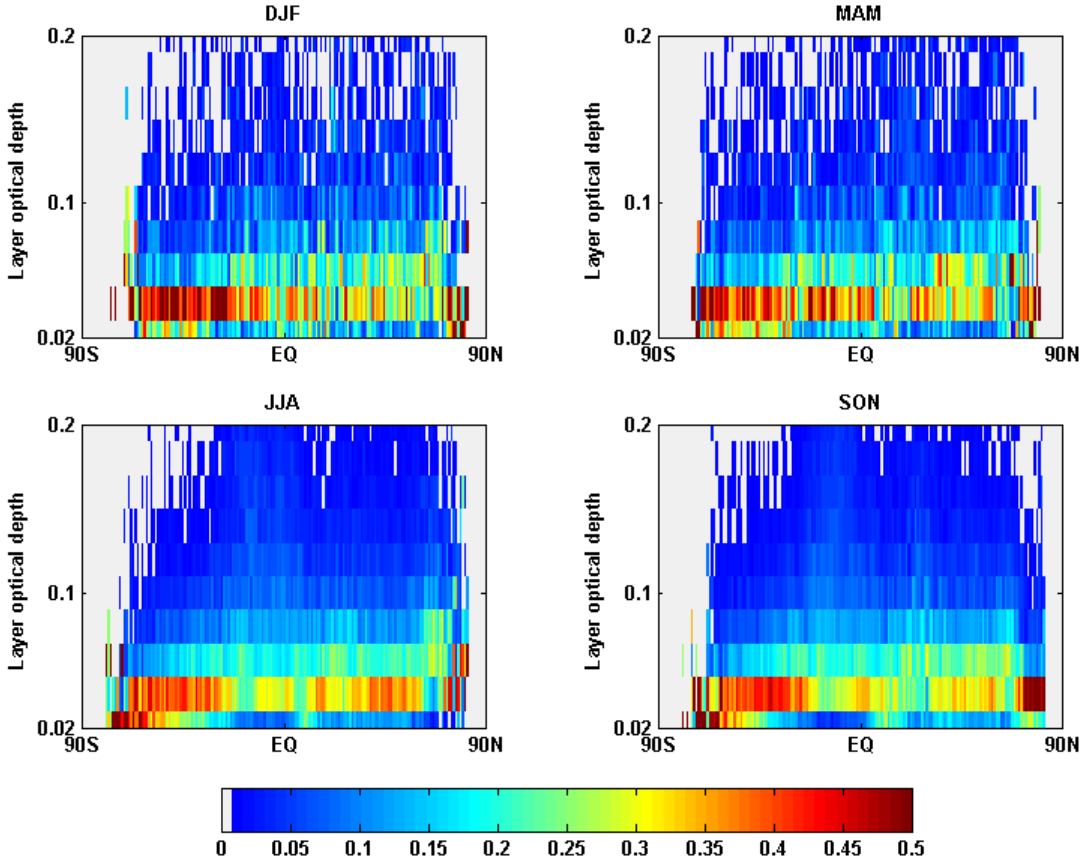
case studies, these quality criteria can be relaxed. Such broad range of sensitivity suggests that there is still some room for improvements in the feature detection algorithm.




2) In the original manuscript, we focused only on the macrophyiscal properties of aerosol and cloud layers mainly because a) these are the fundamental products from the CALIOP sensor (i.e. defining boundaries of the thin features), and b) no previous study investigates and presents similar statistics. We do understand that the feature optical thickness retrievals from CALIOP have now matured enough to use for the scientific analysis and form an important part of its overall capabilities. Therefore, following your suggestion, we additionally investigated aerosol layer optical depths during overlap events, and we have added the following the text and figure accordingly in the revised manuscript.

As an aerosol optical depth is one of the key properties required to ascertain radiative impact of the overlying layers, we examined the zonal seasonal distribution of optical depths of the overlying aerosol layers as shown in Fig. 6 for the AAO case. Each bin in Fig. 6 is 0.02 optical depth units by one degree latitude. Each optical depth bin along y-axis is normalized by the total number of observations at a particular latitude bin, thus providing the fraction of observations represented by each optical depth bin at that particular one degree latitude. Over the polar regions, more than 50% of the overlapping aerosol layers have optical thickness less than 0.02, but the contribution from the relatively optically thicker aerosol layers increases towards the equatorial regions in both hemispheres. In the tropics and the mid-latitudes, roughly 30-50% aerosol layers have optical thickness in the range of 0.02-0.04. About 10-20% of aerosol layers have optical depths greater than 0.1 over these regions. There is also seasonality in the distribution of

aerosol optical depths during overlapping events. In the summer half-year (i.e. from June till November), the frequency of occurrence of the optically thick aerosol layers (with optical depth > 0.1) is at least twice to that of the winter-half year.




3) The abstract is shortened in the revised manuscript, while keeping the important details.

4) As per the referee's suggestion, the figures 1, 3 and 4 are revised and plotted with lesser white spaces between the panels to improve clarity. The figures 5 and 6 are kept unchanged (note that the numbers of these figures are changed in the revised manuscript). In case of figures 5 and 6, the 3D statistics is squeezed into 2D plots by partitioning data zonally into six latitude bands (and for four seasons). In spite of trying, we found it difficult to present all this information in one figure while satisfying space requirements. The figure 7 is now plotted with clearer axes.

5) Few more references are added in the revised manuscript.

6) We have addressed all grammatical errors raised by the referee and their corrections are highlighted by yellow background colour in the revised manuscript for quick reference.

We hope this revision will satisfy the ACP standards and requirements, and we will be happy to work further if needed.