Review 1

General: A clear understanding of anthropogenic dust emission is critical for predicting how changes in land usage (and thus changes in land use policies) will influence dust emission, loading, and deposition in the future. However, the assessment of the role of anthropogenic activity in the atmospheric dust cycle is limited by the accuracy of the available data sets. CALIPSO can provide new insight into the detection of global anthropogenic dust emission due to its measurement of vertical resolution and depolarization ratio. The authors of this manuscript developed a new technique for detection of anthropogenic dust emissions by using CALIPSO lidar measurements and used this algorithm to analyze its global distribution. In general, I found the paper well written and appropriate for ACP audience.

I recommend accepted this paper for publication in ACP with addressing those comments listed below:

Response: We are very grateful for the reviewers' detailed advice and constructive comments on the manuscript; they have been very helpful, and they have led to significant improvements in this paper. We are grateful for and agree with all of the proposed suggestions. In accordance with these suggestions, we have revised the manuscript fully. In addition to our detailed responses to the comments shown below, we have also clarified some interpretations.

1. Page 10167, line 10: It will be much better if authors can provide more detail explanation about meaning of the sentence: "The larger the magnitude of the CAD score, 10 the higher our confidence that the classification is correct. Liu et al. (2010) revealed that the confidence in the classification is high with $|CAD| \geq 70$ in Version 3. Based on this, we only include features with absolute values of CAD score greater than 70 in this study."

Response: We appreciate the insightful suggestion provided by the reviewer #1. We have added some sentences as following to explain above issue " Liu et al. (2010) revealed that the feature classification is more reasonable by using higher magnitude of absolute CAD

score and suggested the absolute values of selected CAD score is larger than 70. In our study, we selected a features where the $|CAD| \geq 70$ as well.

2. Page 10173, Line 20 to page 10174 line 10: Author should move section 4 before section 3 and change the title as "Calculation of dust column burden (DCB)"

Response: Thank you for your suggestion. We have moved the original section 4 to the front of original section 3 and change the title as "Calculation of dust column burden (DCB)"

3. Page 10176 line 15 to 19 lines 3: Authors need to provide more discussions about Fig. 7.

Response: We have added some sentences as follows: "where less anthropogenic dust aerosol due to the less human activities".

4. Page 10178, line 16 to 23: Authors need to provide more discussions about Fig. 10.

Response: We have added more description as follows: "The anthropogenic dust contributions to regional emissions from Eastern China and India are 91.8% and 76.1%, respectively, followed by North America, with 73.9%. In recent years, urbanization and human activities have increased in eastern China; thus, its annual mean contribution of anthropogenic dust is the largest, approximately 91.8%. In Africa, the Sahara Desert is a rich source of natural dust. Although the anthropogenic dust contribution is minimal, it is greater than in North America and eastern China. A lower amount of urban construction and human activity in North America means that both its anthropogenic dust content and contribution are the lowest of the four regions. A possible explanation for the above phenomenon is that eastern China and India have larger population densities and thus more intense agricultural and human activities."

5. Page 10179, line 4-24: Authors should discuss some uncertainty of this method in discussion section.

Response: We have added some sentences as follows: "Another mainly uncertainty

sources of the method are from the uncertainty of estimation of PBL height and MODIS land cover".

6. JQSRT published a paper about the depolarization of linearly polarized light (Sun, W., Z. Liu, G. Videen, Q. Fu, K. Muinonen, et al., 2013: For the depolarization of linearly polarized light by smake particles, Journal of Quantitative Spectroscopy & Radiative Transfer, 122, 233-237). Please reference this paper to increase reader understanding of the method.

Response: We have cited and acknowledged the earlier work by different authors.