Atmospheric
Chemistry
and Physics
Discussions

Interactive comment on "Comparison of the optical properties of pure and transported anthropogenic dusts measured by ground-based Lidar" *by* Zhijuan Zhang et al.

Zhijuan Zhang et al.

zhangzj2010@lzu.edu.cn

Anonymous Referee #1

General Comments:

"Comparison of optical properties of pure dust and transported anthropogenic dusts measured by ground-based Lidar" describes two cases and statistical analysis of pure and anthropogenic dust based on the polarization sensitive lidar observations. The depolarization ratio by lidar is an important parameter for dust studies, but authors utilize "volume depolarization ratio" which represents non-sphericity of particles in qualitative

manner because it depends on scattering ratio. At least "particle depolarization ratio" should be used to describe the characteristics of dust quantitatively. Also authors should clearly distinguish the mixing of dust and pollutant "internally" or "externally" throughout the study. From these points of view, this manuscript must be fundamentally revised before publication.

Thank you for your serious review. After your suggestion, we are now calculating the particle depolarization ratio and correcting other related expression. First, linear volume depolarization ratio is provided by SACOL group and is used as a part to detect pure dust and anthropogenic dust. This method is the same with Huang et al. (2015) and Liu et al. (2005). This work is mainly to further prove the detection method of anthropogenic dust in Huang et al. (2015). Second, owing to the vertical resolution of lidar, we can observe a bin of 6 meters in vertical direction. So in this air column there are many dust aerosols rather than one, so we think the mixing state is difficult to find out if we only use the NIES lidar. Compared with the CALIPSO observation, the mixing state of dust has not been considered in a good manner in the algorithm of aerosol subtype. But if we clarity the mixing state of dust aerosols, the work will be more accurate and interesting. This work is basic and it still needs to improve in the future. And we will address all those problem in the next work.

Specific Comments:

1. Spelling "Lidar" is not common. Just "lidar" is adequate.

Thank you for your kind reminding. We have corrected in the corresponding position.

2. L128, what is the time resolution of surface weather data?

Sorry for our ignorance of that. The time resolution of surface weather data is daily.

3. L134, refer Figure 1.

Thank you for your kind reminding. We have corrected in the corresponding position.

4. L190, Winker et al.(2009, not 2006) compared the detectors in CALIOP, not the lidar in SOCAL.

Thank you for your kind reminding. Winker et al. (2009) compared the detectors in CALIOP and used attenuated backscatter coefficient at 532 nm to discriminate clouds and aerosols, rather than 1064 nm. We referred that literature to illustrate that we also choose attenuated backscatter coefficient at 532 nm to discriminate clouds and aerosols, rather than 1064 nm. As your kind reminding, we have corrected in the corresponding position.

5. L201, the depolarization ratio represents statistical properties of particles in the observed volume, not a single particle. Eq(2), how did author retrieve beta1064? By Fernald method?

Yes, you are right. The depolarization ratio represents statistical properties of particles in the observed volume. We used this physical variable in our detection method, as used in Huang et al. (2015) to detect anthropogenic dust. The second question, we retrieve beta1064 in Eq(2) by Fernald method. .

6. L228, does low DEP and high CR correspond to pollution? It seems coarse sphere, like sea salt.

According to our results in our manuscript, the DEP of polluted dust is relatively low compared with pure dust, but it is relatively high than that of sea salt. Because only when the DEP of aerosols is greater than 0.06, can this kind of aerosols be picked out. So in this step sea salt is removed. On the other hand, the CR of polluted dust is 1.1 and for sea salt it is 0.53. When we pick polluted dust, the threshold of CR is greater than 0.6. So the sea salt cannot be picked. According to above two steps, low DEP and high CR corresponds to polluted dust, not sea salt.

7. L240, if dust is reported at stations and dust layer is detected above PBL by lidar, is it pure or transported?

We thought it was pure dust. Because pure dust is accompanies with dust days, like dust storm, blowing dust and floating dust. For every case we picked out, IDL procedure was fist conducted, and then we confirmed them with our eyes. Under your constructive suggestion, we have modified our detection method and picked pure dust and polluted dust again.

8. L318, what is the target of statistical analysis? All data during October 2009 and June 2013? Or, some restriction by scattering ratio? What is the height range?

We did statistical analysis to find the threshold between pure dust and polluted dust from the optical perspective and further to improve the detection of different aerosol type in numerical modeling and satellite algorithm. Not all data during October 2009 and June 2013. Owing to the output energy of the NIES equipment low, some data during this period is not useful. Also we have conducted strict data quality control. Every case was strictly picked out using IDL source code and after that we confirmed every case personally with our eyes. The original data height range is 0 to 18 km, but considering our requirements, 0 to 6 km above the ground is chosen because aerosols are concentrated in this height range.

9. L367, what is the physical meaning of skewness and kurtosis for histograms?

Mean value alone cannot describe the distribution of pure dust and polluted dust, so we add skewness and kurtosis to help us to detect them clearly in the space-born lidar and numerical modeling. Skewness is a measure of the direction and extent of skewness in the distribution of statistical data and is a numerical feature of the degree of asymmetry in the distribution of statistical data. The number of features characterizing the degree of asymmetry of the probability distribution density curve with respect to the mean. Intuitively, it is the relative length of the tail of the density function curve. In our results, take depolarization ratio for example, skewness of pure dust and polluted dust are greater than 0, which means they all located on the right less than the left. But the skewness of pure dust is smaller than that of polluted dust which means for pure dust

the number of large values is larger. So using this distribution we can constrain the satellite observation and model results when detecting dust aerosols.

10. Figure 1, describe the time period in which the number of dust events were counted.

The time period in Figure 1 is 2013, one year data.

11. Figure 3 and 5, unit for panel (a) is unnatural. Is it 10Ë̈Ę-2/km/sr?

Thank you for your kind reminding. We have corrected in the corresponding position.

12. Figure 3, PBL height at 0 UTC was above the cloud layer. How lidar can detect it without effective signal?

Thank you for your kind reminding. As you said, when it is cloudy, we cannot get accurate PBL. The case in Figure 3 is not appropriate and we modified the selection method and changed another case.

13. Figure 4 and 6, all trajectories touch the ground. Are these paths reliable?

Thank you for your kind reminding. Out of our ignorance, those paths may not be reliable. According to the path and altitude, we picked out every case again.

14. Figure 9, (b) for pure and (a) for anthropogenic dust.

Thank you for your kind reminding. We have corrected in the corresponding position.

Technical Corrections:

1. L53, L58, L89 etc, unify the usage of "," and ";".

Thank you for your kind reminding. We have corrected in the corresponding position.

2. References, J. Quant. Spectrosc. Radiat. Transfer

Thank you for your kind reminding. We have corrected in the corresponding position.

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