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## ***Interactive comment on “Vertical variation of optical properties of mixed Asian dust/pollution plumes according to pathway of air mass transport over East Asia” by S.-K. Shin et al.***

### **Anonymous Referee #2**

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This manuscript presents a long-term study of multi-wavelength lidar observations of Asian dust and mixtures of Asian dust with anthropogenic pollution over Gwangju, Korea. The results are interesting and valuable. Therefore I recommend publication in ACP after revision of the manuscript.

Major comments:

Section 3, Figure 3: The general discussion of the retrieved values should consider the transport way/height. One would expect that the two different cases are also visible in the frequency distribution of the retrieved optical properties. Please comment on this.

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p. 3389, l. 21 - p. 3390, l. 19: The consideration of all measurements to derive and discuss mean values and to compare these mean values to former findings is misleading as the authors assume differences in the investigated aerosol layers with respect to mixing of dust and pollution. Furthermore the authors assume mixtures of dust and anthropogenic pollution, but the discussion and comparison to former findings is limited to the values of mineral dust. The discussion should be extended to former findings/measurements of pollution aerosols.

Section 3.1: This discussion is misleading as not only ‘the level of pollution emission’, but also the transport height above the polluted area has to be included in the separation. In consequence one would expect different results for the so called LP and MP cases, but the results are very similar for both cases. However, it is obvious, that two different clusters can be seen in the results supporting, that different aerosols/mixtures have been observed. This is also shown in Section 3.2 taking the transport way into account.

Section 3.2: It would be valuable to include a frequency distributions of the retrieved optical properties separated for the both cases.

Minor comments:

Within text and figures the authors mostly only use the expression ‘depolarization ratio’. Please make sure whether the volume or the particle depolarization is meant, and change text and figures accordingly.

p. 3384, l. 24: change ‘Asian dust plumes’ to ‘aerosol plumes’

p. 3386, l. 6: A short description/summary of the main parameters of the lidar system would be nice.

p. 3386, l. 21: give the height of full overlap for  $\alpha_p$  measurements and thus for S-profiles.

p. 3387, l. 20: Do the authors use the volume or the particle depolarization ratio?

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p. 3388, l. 6-7: 'Asian dust is generally composed of a mixture of pollution. . .' – this sentence is misleading. Observations were performed for a variety of mixtures of dust and pollution leading to a variety of  $\delta\rho$ -values. p. 3388, l. 11: Measurements of pure 'aged' dust plumes (e.g. SAMUM-2) did not show any changes in the retrieved particle depolarization ratio with respect to fresh pure dust. Thus the threshold was used to determine dust in aerosol mixtures.

p. 3388, l. 19-20: Do the  $\pm$ -values indicate the uncertainty of the mean or the standard deviation of the mean?

p. 3389, l. 8-19: How do MACC analyses agree with measurements from satellites and with observations of your lidar measurements?

p. 3389, l. 21-22: What is the splitting of the 38 observed dust layers to high and low transport path above China, and to the observed height range above your site?

p. 3390, l. 19: What do you mean by 'moderately aged'? Do you really mean aging (shape/size dependent sedimentation, coating, . . .)?

p. 3391, l. 28-29: This sentence is misleading as the lowest S-values in the high  $\delta\rho$ -cluster are found for the lowest  $\delta\rho$ -values within this cluster. Please change or comment on this.

p. 3393, l. 8-10: Please change to 'mean values of the particle depolarization ratio . . .' as single measurements agree well with former findings of pure dust layers.

Figure 3: Why does the shape of Lidar ratio distribution at 355 nm differ from the shape of Lidar ratio distribution at 532 nm?

Figure 3: An additional plot of the trajectories height would be valuable.

Figure 6: It should be indicated which colors denote to which case.

Figure 7: Color coded trajectories according to their heights above the lidar site would improve this Figure.

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Figure 8: What are the black lines?

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Interactive comment on Atmos. Chem. Phys. Discuss., 15, 3381, 2015.

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