Authors' response to Referee #1' comments

Paper No.: ACP-2014-1030

Title: Vertical variation of optical properties of mixed Asian dust/pollution plumes according to pathway of airmass transport over East Asia

We would like to give many thanks to you for the invaluable comments. We found your comments provided significant value to us in preparing the revised manuscript. The criticism and suggestions by you were appropriate and improved the quality of our manuscript. We therefore responded and will revise our original manuscript to address all of the concerns raised.

A point by point response is given below.

Thank you very much for reconsidering this manuscript

Anonymous Referee #1

General comments:

This present study investigates optical property variations of mixed Asian dust with anthropogenic pollution according to the pathways and vertical distributions during long-range transport. The authors find a decrease of the linear depolarization ratio of the mixed dust/pollution plume in dependence of transport time if the pollution layer travelled over China at low heights, i.e., below approximately 3 km above ground. We can separate aerosol types as anthropogenic pollution particle, smoke particle, sea-salt and dust in the atmospheric aerosol study. However, the mixed aerosol is observed in the many cases, especially in Asian dust. Asian dust particles, which originate from desert areas in the Asian continent, can be mixed with polluted aerosols that contain black-carbon and/or smoke particles while they are transported over industrial regions. This mixture of dust particles with anthropogenic particles causes changes in optical properties of dust layers. The increased radiative forcing exerted by East Asian dust plumes can be largely attributed to the presence of highly light-absorbing anthropogenic particles that are mixed in dust layers. However, the vertical structure and the degree of vertical mixing between dust and pollution layers during transport are poorly understood, primarily

because of the lack of vertically resolved observations of aerosol pollution. In this respect, the results presented in this study are expected to be able to help the understanding of the degree of mixing of dust. In general, this manuscript is well organized and the results are valuable for improving our understanding of the dust particles and the mixing status of dust and pollution particles. The manuscript should be published in "Atmospheric Chemistry and Physics". But it requires some minor revision before to be published.

Comments:

Line 59 : 63±9 sr at 355 nm and 62±8 sr at 532 nm, respectively -> 63±9 and 62±8 sr at 355 and 532 nm, respectively

Response: It will be changed as "63±9 and 62±8 sr at 355 and 532 nm, respectively" at line 61 of the revised manuscript

Line 85, 87 : Change the order of references by year.

Response: The order of references will be changed as order by year as below

- line 88 of revised manuscript : such as ACE-Asia (Huebert et al., 2003) and ADEC (Mikami et al., 2006)

- line 90 of revised manuscript : . Carrico et al. (2003) and Yu et al. (2006)

- line 94 of revised manuscript : (Wang et al., 2007; Sun et al., 2010)

Line 128 : Add "at 532 nm" after "depolarization ratio"

Response: The word "at 532 nm" will be added at line 139 of revised manuscript

Line 137 : Please denote the minimum observation altitude of extinction coefficient.

Response: The sentence "The α_p can be retrieved above 780 m and 540 m at measurement

wavelength of 355 nm and 532 nm." Will be added at line 149 of revised manuscript

Line 142, 146 : Authors used "co-polarized and cross-polarized" in line 142 to explain depolarization ratio. But, "perpendicular and parallel" were also used in line 146. Those expressions are different? If those intend to deliver the same meaning, Please consider using just one of them throughout the manuscript or try to define them together.

Response: The words "co-polarized and cross-polarized" and "perpendicular and parallel" denoted same meaning. The statement will be changed as "Parallel polarized and perpendicular polarized signals are measured at 532 nm." at line 185 of revised manuscript

Section 2.2 : What is the threshold level of depolarization ratio to identify dust layer?

Response: We used 0.08 as a threshold value to identify dust. The statement "In this study 0.08 was considered as threshold value of δ_p to identify dust." will be added at line 222 of revised manuscript.

Line 182 : as low -> low as

Response: It will be changed from "as low" to "low as".

Line 214-215 : Insert the standard deviation for each mean value.

Response: The standard deviations of each value will be added as "The average value of δ_p for all observed Asian dust layers is 0.17±0.02. The average values of S are 57±6 sr at 355 nm and 57±7 sr at 532 nm. The mean value of $Å_\beta$ is 0.84±0.37." at line 266-267 of revised manuscript.

Section 3.1, line 238-241 : The sentence is hard to understand. How do you classify the dust layers as two episodes? Dose the sentence from line 255 to 261 account for two episodes? If yes, move that sentence to the front of this section and then reorganize the sentence.

Response: The sentences "On the basis of the distribution of AOD of anthropogenic pollution over China, the Asian dust layers were classified as "more polluted", i.e., "MP" Asian dust when the modelled AOD of anthropogenic pollution on that day was higher than the average AOD (modelled) of all 32 observation days considered in this study. In contrast, Asian dust layers that passed over China during episodes of lower AOD, i.e., AOD was below the mean value of modelled AOD of all 32 observation days are denoted as "less polluted", i.e., "LP" Asian dust." will be moved to front of section 3.1 to clarify two episode as your comment.

Line 292 : What kind of the model do you use? You just mentioned "model results".

Response: We used the HYSPLIT mode result to determine the height of the dust layers above ground during transport over China. The statement "The vertical positions of the dust plumes above ground during transport over China were inferred from the model results. We assume that the height of the dust plumes above ground can be distinguished by HYSPLIT model results although the results may have a certain error because of the spatial and temporal complexity of the meteorological fields involved in the computations." will be added at line 345-349 of revised manuscript

Line 307-310 : Remove those sentences. The sentences are same with the sentences in line 216-218.

Response: It has been removed.

Line 437 : Instead of "high altitudes", display the correct altitude.

Response: The statement "at high altitudes, i.e., above 3 km." will be added instead of high altitudes at line 436 of revised manuscript

Table 1, 2, 3 : Lidar ratio -> Lidar ratio (sr)

Response: It will be changed as "Lidar ratio (sr)" in all of tables in revised manuscript

Figure 2 : VDPR, PDPR, LR532, LR355, Bsc. Ang. 355/532 -> Use the symbol in the manuscript.

Response: The symbols in figure 2 will be changed as symbol used in text in revised manuscript.