

Manuscript No.: **acp-2016-764**

Journal: **ACP**

The revised manuscript entitled “**Comparison of key absorption and optical properties between pure and transported anthropogenic dust over East and Central Asia.**” by Jianrong Bi, et al.

**Anonymous Referee#3:**

The work presented in this paper is very interesting and well structured. The authors suggest a method for discriminating the presence of Desert dust in the atmosphere, dividing it into two different cases: pure dust and transported anthropogenic dust. The method is based on a threshold on AOD (440 nm) and Angstrom exponent (calculated using the two wavelengths 400 and 870 nm), and provided good results when compared with the plots of the volume size distributions. Also the section devoted to the comparison among the values retrieved from measurements and the ones from models generally used, is very interesting and useful.

**Response to Referee#3:**

We are grateful to the Editor and the anonymous Referee for their constructive and insightful comments. The comments of the Referees are helpful and valuable for greatly improving the manuscript. Please find a point-by-point reply to the issues as follows (highlighted in blue color font). And we have also uploaded the file of “Response to-Referee#3(acp-2016-764)-supplement.pdf”.

- (1) To complete the paper, I suggest the authors to give a look to the following paper where a similar work has been done for Saharan dust in Europe: “Inventory of African desert dust events over the southwestern Iberian Peninsula in 2000-2005 with an AERONET Cimel Sun photometer”, Toledano et al., 2007, DOI:10.1029/2006JD008307. Also in this paper thresholds on Angstrom exponent and AOD are used in order to set up an Automatic Criterion for Detection and Evaluation of Desert Dust Intrusions and, as expected, they are different from the

ones used in this paper. I think it should be highlighted in the text that the chosen values are good for the type of dust intrusion of the selected area, and that for a smaller area or a different geographical location, they must be selected carefully. In that paper it is also written that a larger sensitivity to the presence of dust particles has been found at 870 nm rather than 440 nm. Do the authors think that using a threshold on this wavelength in the case of TDU would help to discriminate more accurately the amount of dust from the anthropogenic aerosols? Did the author never found (in TDU dataset) a 3 modal volume size distribution? If yes, it could be another possibility for better understanding the composition of TDU dust.

**Response:** Thank you very much for Reviewer's insightful comments. We have read carefully the paper of Toledano et al. [JGR, 2007]. In their Automatic Criterion for Detection and Evaluation of Desert Dust Intrusions, they mainly based on AOD and Angstrom exponent ( $AOD(870nm) > 0.11$  and  $\alpha < 0.99$ ), manual inspection, and volume concentrations (fine and coarse modes), and confirmation with back trajectories and satellite-constitute the basic methodology to establish the inventory of African dust events. As pointed out by Toledano et al., "In principle the criterion derived here for the detection of desert aerosol events is only valid for our site, that is, it is a local criterion." (Page 11).

If we used the threshold on 870 nm wavelength ( $AOD(870nm) > 0.11$  and  $\alpha < 0.99$ ) to identify the TDU in our manuscript, we found that there were a lot of cases meet this condition, that is, both dust aerosols and the other aerosol types (e.g., urban-industrial aerosol) have got  $AOD(870nm) > 0.11$  and  $\alpha < 0.99$ . Therefore, we could not discriminate among the pure dust, TDU, and fine-mode dominated non-dust aerosols in our study. Meanwhile, we have checked the TDU datasets at all selected sites in our paper, we only found that there were only a few TDU cases (less than 1%) with a 3 modal volume size distribution. Anyway, we greatly appreciated the Referee's insightful comments, and we would bear in mind these good suggestions in our future work.

**Minor comments:**

(1) Line 189: put the acronyms of SSA, ASY, Ri and Re in line 186, where these quantities are listed.

**Response:** Thank you very much for Referee's good comments! We have presented the full name of SSA, ASY, Ri and Re in Lines 145-146, so we used the acronyms here.

(2) Line 192: "are dependent on  $AOD_{440} \geq 0.4$ " I think it would be better saying "are valid for  $AOD_{440} \dots$ "

**Response:** We have changed "are dependent on" to "are valid for" in Line 192.

(3) Line 277: "capability" instead of "intensity"

**Response:** We have changed "capability" to "intensity" in Line 277.

(4) Line 346: it is written that the pick radius of the coarse mode is about 2.24 for both PDU and TDU. However for Yulin in TDU it seems to be about 3. I think that in the case of TDU it would be better saying that the pick radius is between 2-3  $\mu\text{m}$ .

**Response:** Thank you very much for Referee's insightful comments! The  $r_{vc}$  of TDU cases actually vary between 2 to 3  $\mu\text{m}$ . So, we have changed "for all PDU and TDU cases" to "for all PDU cases and  $r_{vc} \sim 2.0-3.0 \mu\text{m}$  for TDU cases" in Line 346.

(5) Lines 512-514: the sentence begins with "because" but it doesn't seem to have a correct grammatical structure (subject, verb, object...). Please check it.

**Response:** We have deleted "because" and changed to "It is very difficult to quantify the anthropogenic contribution due to large uncertainties in defining..." in Lines 512-514.