

General Comments:

Tian et al. discuss aerosol particle polarization properties from November 29, 2015 to July 29, 2016 at Beijing. The dataset presented is interesting, particularly in showing particle polarization in anthropogenic pollution, mixed type pollution and pure Asian dust cases. Using an optical particle counter equipped with a polarization detection module is a new method to study mixing processes. However, the discussion in the current draft is insufficient for these data and results: a number of results/conclusions are not obtained from lab experiment or data prove, just derivate from published paper. I believe the article therefore should add data prove or lab experiment, and require major revisions.

Specific Comments:

1. Page 2, Line 2-3, only consumption of fossil fuel lead serious air pollution in East Asia? How about vehicle exhaust?
2. Page 2, Line 6, mineral dust particles only originated from natural sources? In the manuscript 3.4 part, the authors said emissions in famous mining areas in China can result in a huge amount of dust.
3. Page 3, Line 3, the authors should add more descriptions about depolarization of aerosol particles.
4. Page 3, Line 4-5, the authors said studies on the polarization characteristics are necessary, how about depolarization characteristics?
5. Page 3, Line 10-14, why key pollutants and meteorological data were obtained from two different sites? The key pollutants and meteorological data are the same in the two different sites?
6. Page 4, Line 28-29, why 150 m above ground level was chose? Why not is 100m or 200m? Why the simulation time of the backward trajectory is 5 days, not 3 days or 2 days?
7. Page 5, Line 9-11, What about the sources of particle size in $1\ \mu\text{m} - 4\ \mu\text{m}$? A number of published papers said that $\text{PM}_{2.5}$ also mostly derived from anthropogenic sources. The reference of Kurosaki and Mikami, (2003) is a bit old.
8. Page 5, Line 24-26, the depolarization ratios of fine mode particles in summer are not lower than any other season? Why the authors emphasized depolarization ratios of particles with an optical diameter of $2\ \mu\text{m}$ are lower than any other season?
9. Page 6, Line 4-7, wind speed, biomass burning or other factors have no impact on high depolarization ratio? Only transport lead high depolarization ratio?
10. Page 6, Line 7-10, have the authors ruled out other factors (such as wind speed, biomass burning)? These factors also can lead high $\text{PM}_{2.5}$.
11. Page 6, Line 30-31, the authors said “Mixed type pollution was also necessary for substandard days in Jan. (44%), 30 Feb. (50%), and Apr. (35%)”. But in Page 5, Line 17-18, the authors said mixed type pollution is “B” (March 3rd to 4th, 2016). And please clearly describe how to decide mixed type pollution.
12. Page 7, Line 7-9, the authors obtained the conclusion is based on the report in published papers, not obtained from the authors’ observation or lab experiment.

So possibly the conclusion didn't confirm.

13. Page 7, Line 25-26, why the authors confirm that increasing PM_{2.5} level in case A was caused by weak diffusion conditions and high relative humidity? How about other aspects, such as emissions?
14. Page 7, Line 29-33, Fig, 7b didn't present height of air parcel, and in the paper, the authors also didn't present descriptions about height of air parcel in the draft. Why the authors can get conclusion that emissions in mining areas can lead a huge amount of dust? And in the paper, the descriptions about emissions in mining areas in March 3 to 4 are also not given.
15. Page 8, Line 6-9, please connected the cited part of Itahashi et al. (2010) with your study.
16. Page 8, Line 15, please give data prove or corresponding references.
17. Page 8, Line 16-17, how does the author judge no anthropogenic pollution emissions in case C, and obtain a pure dust process? In the paper, there are no data prove.
18. Page 9, Line 21-22, why the authors use PM_{2.5}/PM₁₀ ratio? In 3.1 part, the authors said the fine mode (<1 μm), the coarse mode (4 μm – 8 μm). Why the authors didn't use PM_{1.0}, PM_{4.0-8.0}?
19. Page 9, Line 25-26, generally we firstly presented some evidences, such as data prove or results in published paper, then derivated possible conclusion.
20. Page 9, Line 29-31, the result was obtained by the authors' lab experiment? If no, please add data prove or references.
21. Page 10, Line 3-20, please give corresponding data prove or lab experiment, then obtain conclusions.

Minor Comments:

1. Page 5, Line 11-13, "The growth of fine mode particles mainly stems from high anthropogenic emissions during heating seasons." confused with "The distinct growth period of fine mode particles was usually induced by an increase in relative humidity (i.e., RH)". Please afresh write the two sentences.
2. Page 6, Line 31, what is JJ? Please explain it.
3. Page 7, Line 3,4, NO_x should be NO_x.
4. Page 8, Line 6, please clearly point out "dominant mechanisms". What were dominant mechanisms?
5. Page 8, Line 10-11, the authors said the first processes (22st -23rd, Dec. 2015) and the third process (9th, Apr. 2016). But in Page 5, Line 17-18, the authors said "A" (December 22nd to 23rd, 2015), "B" (March 3rd to 4th, 2016) and "C" (April 9th, 2016), respectively. Please unite.
6. Page 8, Line 15, please added data descriptions or references for "primary anthropogenic pollution emissions in this period were also lower compared to the winter time".
7. Page 9, Line 23-25, please added references.
8. Figure 7f, the date is 04/10/2016, not 04/09/2016?
9. Page 9, Line 24-25, please added references.