

MS NO.: acp-2015-437

Thanks for The referee#1's comments. Those comments are all valuable and helpful for improving our paper. We answered the comments carefully and have made corrections in the submitted manuscript. The corrections and the responses are as following:

1. Page 24372, line 10-11, here author said "however, aerosols of the vast grasslands of the northern TP have not been studied".
 - a) It is better to briefly state why it is necessary to characterize the aerosols from the grassland atmosphere, if the physicochemical properties of the grassland aerosols are different from those in other places of TP?
 - b) Page 24372, line 18-20, what is the definition of age? Why aged aerosols represent the typical chemical composition of this continental background region? If this means that fresh aerosols are very less at the sampling site and most of airborne particles are long-range transported?

Response 1 a): We added the reasons why we do study aerosol particles in grassland over the TP.

"Grassland is one of the largest geomorphology in the TP. There are only a few herdsmen and farmers living in the vast grasslands of the northern TP. Air pollutants from anthropogenic and natural sources can be easily transported over low bushes in the grasslands under high wind speed in north TP (Figure S1). However, aerosols in the troposphere have not been studied over the vast grassland in the northern TP."

Response 1 b): Here we deleted the sentence based on the logic in the paragraph. We added the definition about the "aged" particles in section 4.3

2. Page 24373, section 2.1,
 - a) what is the altitude of the sampling site? This information is important.
 - b) The density of particles is assumed to be 2 g/cm³, what is the rationale?

Response 2 a): We added

Response 2 b): We usually used the value to calculate the size cut off of the impactor. We consider ammonium sulfate (1.77 g/cm³), mineral dust (2.6 g/cm³), and organic matter (1.5 g/cm³) as the major aerosol types. The average density (calculated at 1.96) of the mixed aerosol particles was assumed to 2 g/cm³.

3. Page 24376 and 24391, Table 1, it's better to give more data such as the standard

deviation, minimum, and maximum values, because data here are statistic numbers; the mean value itself does not give enough information.

Response 3: Thank you. We add standard deviation, min, and max value.

Table 1 Concentrations of six air pollutants during the sampling period, two pollution periods, and clean period

Pollutants	All data		polluted period-1		polluted period-2		other period	
	mean \pm SD	n	mean \pm SD	n	mean \pm SD	n	mean \pm SD	n
	Max, Min		Max, Min		Max, Min		Max, Min	
PM _{2.5}	17.06 \pm 1.39	715	17.6 \pm 1.46	152	24.45 \pm 5.12	99	15.32 \pm 0.41	464
	68.70, 0.20		59.10, 0.20		68.70, 0.30		62.80, 0.20	
BC	0.54 \pm 0.42	805	0.55 \pm 0.52	176	0.85 \pm 0.50	119	0.47 \pm 0.40	510
	3.73, 0.02		3.73, 0.04		2.04, 0.02		3.73, 0.03	
SO ₂	1.27 \pm 1.34	8822	1.2 \pm 0.99	1981	2.73 \pm 3.09	1063	1.03 \pm 0.65	5778
	13.93, 0.02		8.43, 0.20		13.93, 1.41		8.43, 0.02	
NO _x	2.05 \pm 1.96	8842	2.37 \pm 1.33	2001	3.41 \pm 1.70	1063	1.69 \pm 0.97	5778
	9.86, 0.31		9.33, 0.65		9.59, 0.55		9.33, 0.31	
CO	44.78 \pm 48.03	7822	63.45 \pm 55.59	1939	104.23 \pm 54.69	1030	24.68 \pm 39.91	4853
	318.00, 0.20		318.00, 0.20		272.40, 0.60		318.00, 0.20	
O ₃	50 \pm 7.86	8817	47.87 \pm 7.70	2000	49.01 \pm 10.00	1039	50.53 \pm 7.56	5778
	98.63, 20.43		67.70, 26.66		98.63, 20.43		96.77, 26.66	

All data period: 10 Sept.-15 Oct. 2013; Polluted period-1: 18 Sept.-25 Sept. 2013; Polluted period-2: 11 Oct.-15 Oct. 2013

4. Page 24377, lines 5-9, the method for classification of the aerosol types should be briefly introduced, which would be helpful for readers to understand why the particles are categorized as fly ash and others are classified as mineral dust.

Response 4: We briefly introduced the classification.

“For example, mineral dust particles normally display irregular shapes and fly ash particles are spherical, although they both have similar compositions such as Si and Al.”

5. Page 24377, line 6 KCl-NaCl particle. The particle should contain K, Na, and Cl in Figure 4.

- a) The authors didn't show the crystalline of the particle. The name should be changed to K-Na-Cl.
 b) And line 17 organic carbon should be changed to organic.

Response 5 a): We changed the “KCl-NaCl” to K-Na-Cl particle

Response 5 b): We changed the “organic carbon” to “OC”.

6. Page 24378, line 25, 33-36 and 34-48 of what? These percentage numbers are in

mass or particle numbers?

Response 6: These percentage numbers are particle numbers.

7. Page 24379, line 14 Yak dung,

Response 7: We revised this.

8. Page 24380, line 18, what the regional property is? Please give more specific descriptions.

Response 8: We revised the sentence.

“For example, Du *et al.* (2015) suggested that oxygenated organic aerosols from anthropogenic sources and biomass burning transported over a long distance to the sampling site in the QTP.”

9. Page 24380, line 19-20, I do not think primary organic aerosols are refractory. In fact, unlike mineral dust and soot, both are refractory, organic compounds in airborne particles can be completely measured by aerosol mass spectrometer and OC/EC carbon analyzer via heating evaporation, although both instruments can not give molecular information.

Response 9: Thank you. We revised the part.

10. Page 24381, line 10-14, it's better to specifically mark the particles in figures 6, 9 and 10 in order to let readers easily recognize which particle is heterogeneously mixed and which is homogeneously mixed.

Response 10: We specifically point out the heterogeneous and homogeneous mixture. We also added description in each figure caption.

11. Page 24383, line 9-11, this sentence is confusing to me.

Response 11: We revised the sentence as follows:

“However, there is no any report say that the emissions of coal combustion from power plants or other industrial sources have critical regional influence.”

12. Page 24383, line 4 and other places throughout the paper, the authors emphasized many times that aerosols in TP are highly aged.

a) What does the age mean?

b) Aerosols in TP are highly aged, if this statement means that aerosols in other East Asia regions are less aged?

Response 12 a): The reviewer 1 also raised this question. We made one definition to explain the “aged” particle in Section 4.3

Response 12 b): We added one sentence here which can make readers to

understand our true meaning. We just pointed out the aged particles in the TP and don't extend to other East Asia regions. Because aging processes of aerosol particles during their transports can significantly change particle hygroscopic and optical properties, we need to pay attention to the issue. In the study we didn't expect the aged particles (SIA associated with fly ash, spherical organic, soot, and mineral) in the remote site. Obviously, the findings in our study in the remote site are different from one recent result in remote Siberia site (Mikhailov et al., 2015).

“Because the complex aerosol particles from different anthropogenic sources intruded into pristine background air, the suspended aerosols became highly aged.”

- 13.** In the Figure 4 and Figure 5, EDS spectra were obtained from the individual particles or their part. The measured part on the individual particles should be marked. Otherwise, it's hard for readers to know the details.

Response 13: Thanks. We added markers.

- 14.** In Figure 2/7, equivalent spherical diameter should be equivalent volume diameter.

Response 14: We revised those “spherical” to “volume” in section 2.3 and Figure 2/7.