

Interactive comment on “Direct observation of aerosol particles in aged agricultural biomass burning plumes impacting urban atmospheres” by W. Y. Li and L. Y. Shao

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We thank the referee for her/his constructive comments. They have been useful in improving the manuscript. We have tried our best to give adequate answers and we have made corrections in the manuscript according to the recommendations given.

Reply to the Anonymous Referee #1 (Q: question, A: answer):

(Q1) Figure 2- Do the authors have a reason as to why there was no particle collection during June 6-8, when SO₂ and PM₁₀ were at a maximum?

(A1) We collected aerosol samples during June 6-8. The data analyzed by using TEM

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have been used in one published JGR paper. We mentioned this in section 2.2.

(Q2) Page 10596, Lines 13-15: Could the authors briefly state what methods they used for characterizing the particles as mineral, soot, organics, K-rich, S-rich, fly ash, and metals, so that readers do not need to reference in detail (Li and Shao, 2009a)? Were these detected by TEM?

(A2) Thank you for your comment. We detected all kinds of particles using TEM method. In addition, the third paragraph in section 2.2 includes the explanation according to the object of this paper. The sentence was modified below. “The experimental data are based on TEM analysis of individual aerosol particles from the brown haze episodes. We distinguished seven kinds of aerosol particles: mineral, soot, organic matter, fly ash, and K-rich, S-rich, and metal particles (Li and Shao, 2009a).”

(Q3) Page 10596, Lines 21-22: Do the authors have access to any levoglucosan data during the time of the field campaign? As a well-known tracer for biomass burning, this data could strengthen the case for ABB.

(A3) We didn't study the levoglucosan from the aerosol samples in this work. We agree with the reviewer's opinion that the levoglucosan data is the good tracer for biomass burning. In light of the design of this work, we try to strengthen the case of ABB using MODIS wildfire map and back trajectories of air masses beside the TEM analysis of individual aerosol particles. The back trajectories of air masses were added in Figure 8.

(Q4) Page 10604, Lines 16-18: The authors should speculate on the source of the Type-2 haze. If it is not attributed to ABB, do the authors speculate it is from anthropogenic sources?

(A4) Thank you for your suggestion. We added one sentence. “The anthropogenic sources of aerosol particles in the regular haze days (i.e., type-2 haze) in Beijing mainly consist of industry (steel and power plants), transportation, waste incineration, and

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cooking (Li and Shao, 2009a)."

(Q5) Page 10591, Lines 13-14: Sentence reads awkwardly, authors should consider revising. Possible correction: "Agricultural biomass burning (ABB) activities in Asia are drawing worldwide attention due to China's rapid development and increase in agricultural activities."

(A5) Changed.

(Q6) Page 10592, Line 7: "crop straw burning" should be "straw burning."

(A6) Changed.

(Q7) Page 10592, Line 11: What is meant by "burning status"? Does this mean the presence of ABB or regional fires?

(A7) We checked this cited paper, and the definition was added in the sentence. "Zhang et al. (2007) showed that such emissions increased both organic and elemental carbon concentrations and that smoldering and flaming significantly influenced the formation of elemental carbon and polycyclic aromatic hydrocarbons (PAHs)."

(Q8) Page 10592, Line 15-16: Authors should consider revising "timing of farming activities changes from south to north in China" to "timing of farming activities change with respect to latitude throughout China".

(A8) Changed.

Reply to the Anonymous Referee #2:

(Q1) P 10591, Line 13-14, "Agricultural biomass burning (ABB) activities in Asia are : : :ever increasing agricultural activity". The sentence is awkward. This article is not for the news paper. The use of too much decorative words and over emphasized sentences should be avoid in the technical paper.

(A1) Thank for your suggestion. The sentence was changed below. "Agricultural

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biomass burning (ABB) in China is drawing worldwide attention because of its rapid development and increase in agricultural activities."

(Q2) P 10592, Line 16-17, "necessitating that more flexible" Consider using a separate sentence for this part.

(A2) Changed. "First, ABB emissions occur at different times within the spring season because timing of farming activities change with latitude throughout China. Therefore, flexible sampling schedules are needed."

(Q3) 3.2.5 Organic aerosols", This section is very difficult to understand and needs to be rewritten. The authors did not clearly show the feasibility of TEM for organic analysis. TEM requires high vacuum due to the nature of instrumental operation. The atmospheric organic compounds will be easily evaporated from aerosol in the high vacuum system. The authors did not clarify what the impact of the high vacuum on the analysis of organic constitution is in the aerosol particle sample. What the authors observed in the TEM image is not the organics but the skeleton of aerosol. If the TEM is not a strong method to observe the majority of the organic compounds in aerosols, it would better for authors to mainly focus on the inorganic components of the ABB aerosols.

(A3) We modified the section based on the referee's comment. Although semi-volatile organic matter evaporated in the high vacuum, numerous studies have already shown that most organic matter (i.e., non-volatile organic components) can be observed in TEM (Posfai et al., 2003; Niemi et al., 2005; Adachi and Buseck, 2008; Li and Shao, 2010b). In addition, these observed organic matters were stable under strong electron beam exposures. In this study, we try to understand the mixing characteristics of organic aerosols within inorganic aerosol particles instead of analyzing the organic components.

(Q4) 3.3 Identification of the regional hazes affected by agricultural biomass burning In this section, the samples in the study were categorized into two types of haze (type-1

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and type-2) depending on the K/S ratio. This is quite arbitrary. It is likely that same source of ABB can lead to different chemical composition in the downwind area in different days due to the complex atmospheric processes. More evidence should be shown to prove that the “two types” of haze are really from different sources.

(A4) We rewrote this section. Back trajectories of air mass from HE-1 to HE-5 were added in Fig. 7. We found additional studies about the ABB and its associated impacts on Beijing air. We hope that these new data will reduce possible doubts. In this paper, we didn't separate type-1 and type-2 haze based only on the K/S ratio. In fact, we concluded the intense ABB emissions contributed to type-1 haze based on individual particle analysis, wildfire maps and backward trajectories of air masses (added in new version). Therefore, it is more accurate to say that the two types of haze were categorized based on the K-rich particles from individual particle analysis, MODIS fire data, and back trajectories of air masses. In this study, we acknowledged that the slight ABB emission influenced Beijing air quality during the type-2 haze. However, the ABB intensity in the regional scale during the type-2 haze was rather weak compared to type-1 haze. To obtain the reliable data, we, therefore, focused on the investigation of ABB aerosols collected in type-1 haze and further understand mixing mechanisms of individual ABB aerosols.

(Q5) P 10600, Line 9-10. Relative humidity was compared between the two types of haze, which seems to be unnecessary. It may be true that high RH can increase AOD when the aerosol components are same. However, the two types of haze are obviously different in chemical make-up, so it is meaningless to compare the RH effect here.

(A5) We agree with the referee's suggestion. We deleted the discussion about RH and AOD.

(Q6) P 10605, Line 9-11. “As the most populous and fastest : : :”. This sentence is not informative in the conclusion section and should be deleted.

(A6) Deleted.

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References:

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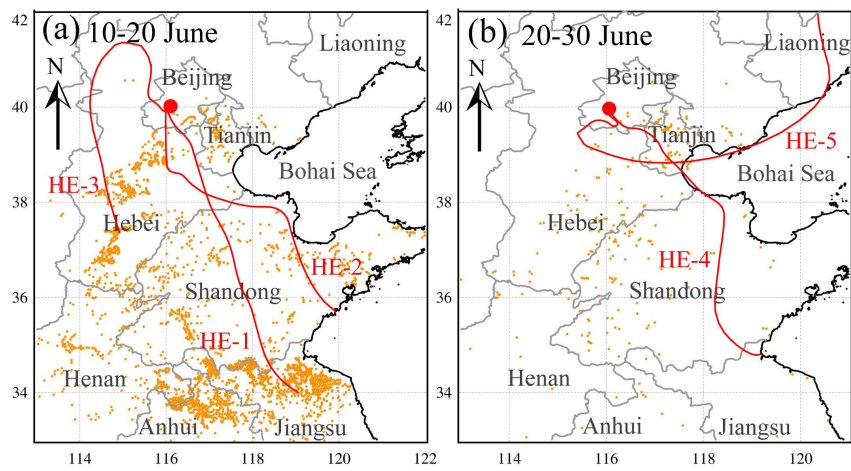


Fig. 1. wildfire maps and back trajectories of air mass