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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The Variability of Relationship between Black Carbon and Carbon Monoxide over the Eastern Coast of China: BC Aging during Transport" *by* Qingfeng Guo et al.

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We thank the referee for his/her careful and critical review of our paper. The following are our responses to the referee's comments.

1) Page 4, L20. The statement "the peak time in Yellow Sea is delayed almost one day than that at Changdao Island" is not obvious in Fig. 3. Some quantitative assessment is suggested such as lagged correlation analysis.

We thank the referee for this suggestion and run the HYSPLIT model at the NOAA website. we have revised Line 31 - 32 in Page 4 and Line 1 - 3 in Page 5 to the following: In order to verify it, the forward trajectory starting at Changdao Island and the back-

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ward one starting in Yellow Sea were respectively run (http://www.ready.noaa.gov). The green line (Fig. S1 in the Supplement) is the 24 hours forward trajectory starting at BC peak time for Changdao Island, and the green one (Fig. S2) is the 24 hours backward trajectory starting at BC peak time for Yellow Sea. They both show that the transport time from Changdao Island to Yellow Sea is about 12 hours, agreed with the peak time lag of 14 hours.

2) It is not clear where the diesel/gasoline consumption data come from in the study.

We thank the referee for pointing this out and add the data source in Line 31 - 32 in Page 5 and Line 1 - 2 in Page 6 to the following: To prove it, the $\Delta BC/\Delta CO$ at different sites are compared with the ratios of the diesel consumption to the gasoline consumption in each province/city (China Energy Statistical Yearbook, 2013) and they show considerable correlation (R2 = 0.63, Figure 5b), which confirms that BC and CO are mainly from vehicular emissions.

3) The authors attributed the outlier (Changdao Island) in Fig. 5b to the fact that it is located in the rural area. Why not exclude this data point in the plot and purely focus on the relationships in urban area? With that, we will obtain a more significant correlation.

We thank the referee for pointing this out and exclude this data point in the figure 5b.

4) In Fig. 4c, each dot of BC/CO ratio is an average over the whole sub-campaign period. However, to accurately study the BC aging during transport, it would be better to pair the fresh BC properties in the source region with the aged one in the outflow region with a proper time lag. The time lag can be decided by the transport efficiency. I am not sure if such a method can be applied in this study.

We thank the referee for this suggestion and will try this method in next study if the data in need are all available.

5) Fig. 2, for which days the wind fields are plotted in each panel?

We thank the referee for pointing this out and add the periods to the caption in Figure

2 to make it clear in Line 4 - 5 in Page 12 to the following: Figure 2. The synoptic wind flow patterns at 925 hPa averaged over Changdao Island (a, the red star, 20 March - 24 April), the first cruise (b, the red line, 17 March - 9 April), the second cruise (c, the red line, 28 May - 8 June), and Wenling (d, the red star, 1 - 28 November) campaign periods as shown in Figure 1. The arrow length and the color show the wind speed, while the arrowhead indicates the wind direction.

6) Fig. 3, the color-coding is a little confusing. If I understand correctly, the black lines are for BC, and the other different color lines are for CO. However, the location names (CD, WL, ES, YS, etc.) are also labeled using the similar colors. Please find a better way to avoid such an ambiguity.

We thank the referee for pointing this out. We label the location names with the black color in Figure 3, and make the caption more clear in Line 2 - 3 in Page 13 to the following: Figure 3. The time series of BC (the black lines) and CO (the lines coded by other colors) during the campaigns of Changdao Island (a), two cruises (b), and Wenling (c).

7) The motivation of BC study in China should be stated in a more thorough way. Recent studies about absorbing aerosol effects on extreme weather and regional climate should be discussed: Wang, et al. “New Directions: Light Absorbing Aerosols and Their Atmospheric Impacts”, Atmos. Environ., 81, 713-715 (2013) Li, et al. “Aerosol and Monsoon Climate Interaction over Asia”, 54, Rev. Geophys. (2016) Wang, et al. “Towards Reconciling the Influence of Atmospheric Aerosols and Greenhouse Gases on Light Precipitation Changes in Eastern China”, J. Geophys. Res. Atmos. 121(10), 5878–5887 (2016)âĂĺ

We thank the referee for this suggestion and discuss the topics in Line 26 - 29 in Page 1 and Line 1 - 3 in Page 2 to the following: The absorption induced by BC is markedly enhanced by the atmospheric oxidation and aging, as investigated by many chamber studies (Peng et al., 2016b;Guo et al., 2016;Schnaiter et al., 2005).

BC aging includes the physical condensation-coagulation and the chemical oxidation which transform BC from hydrophobic to hydrophilic particles (Huang et al., 2013). It not only plays an important role on global BC distribution and budget (He et al., 2016;Huang et al., 2013), but also has a significant influence on BC optical properties (Bond et al., 2006;He et al., 2015). These effects will potentially result in increasing extreme weather and weakening atmospheric circulations (Wang et al., 2013;Li et al., 2016;Wang et al., 2016).

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/acp-2017-56/acp-2017-56-AC2-supplement.pdf

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