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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. Introduction Section: Since this study is focusing on BC aging during transport, there are not enough descriptions/discussions on BC aging process, such as defining BC aging and highlighting the importance of BC aging. For example, BC aging is commonly defined as the physical and chemical transformation of BC from hydrophobic to hydrophilic particles. BC aging significantly influences global BC distribution and budget (e.g., He et al., 2016; Huang et al., 2013) as well as BC optical properties (e.g., He et al., 2015; Bond et al., 2006), further affecting global BC radiative effects. It would



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be helpful if the authors could include these recent studies and add some discussions on this aspect. References: Bond, T. C., Habib, G., and Bergstrom, R.W.: Limitations in the enhancement of visible light absorption due to mixing state, J. Geophys. Res.-Atmos., 111, D20211, doi:10.1029/2006jd007315, 2006. He, C., Liou, K.-N., Takano, Y., Zhang, R., Levy Zamora, M., Yang, P., Li, Q., and Leung, L. R.: Variation of the radiative properties during black carbon aging: theoretical and experimental intercomparison, Atmos. Chem. Phys., 15, 11967–11980, doi:10.5194/acp-15-11967-2015, 2015. He, C., Li, Q., Liou, K.-N., Qi, L., Tao, S., and Schwarz, J. P.: Microphysics-based black carbon aging in a global CTM: constraints from HIPPO observations and implications for global black carbon budget, Atmos. Chem. Phys., 16, 3077–3098, doi:10.5194/acp-16-3077-2016, 2016. Huang, Y., Wu, S., Dubey, M. K., and French, N. H. F.: Impact of aging mechanism on model simulated carbonaceous aerosols, Atmos. Chem. Phys., 13, 6329–6343, doi:10.5194/acp-13-6329- 2013, 2013.

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)

2. Measurement Section: In terms of cruise observations, how large is the impact of emissions from the cruise used for observations? Would the samples be contaminated by emissions of the cruise itself?

We thank the referee for pointing this out. The data contaminated by the ship emission

were screened in our data processing. To clarify, we have revised Line 24 - 26 in Page 3 to the following: For the cruise observation, the data with simultaniously sharp increase in concentrations of BC and CO were screened and excluded from the dataset to avoid the contamination by the ship emission.

3. Page 4, Lines 20-21: Is there any way to verify that the delayed one day in peak time is approximately the transport time between island and Yellow Sea? A simple and quick way is to run the HYSPLIT model at the NOAA website to see if the air mass can be transported from island to the Yellow Sea during that specific day.

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 backward 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.

4. There are a number of English grammatical errors, e.g., Page 5, Line 4 (“much easier remove” should be “much more easily remove”); Page 5, Line 5 (“There are not outlier data” should be “There are no outlier data”); Page 5, Line 11(“north China Plain that emit” should be “north China Plain that emits”). Here are just a few examples. Please double check the entire text.

We thank the referee for the careful and kind help with editing the English and have already examed the entire text.

5. Page 5, Line 6: It’s not accurate to state that "no outliers" indicates "negligible effects of precipitation". This could simply be due to the offsetting effects of different atmospheric processes. So please re-write this sentence.

We thank the referee for pointing this out and delete this sentence to avoid the arbitrariness.

6. Page 6, Line 6: It's not accurate to say "the BC/CO ratio is only associated with BC aging and removal". I suggest using "dominantly" instead of "only".

we thank the referee for this suggestion and have rivesed Line 17 - 19 in Page 6 to the following: When BC transports to the marine boundary layer, the variability in the $\Delta BC/\Delta CO$ ratio is dominantly associated with BC aging and removal, given the insignificant anthropogenic sources in the marine.

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/acp-2017-56/acp-2017-56-AC1-supplement.pdf

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