

Interactive comment on “Alteration of the microphysical properties of black carbon through transport in the boundary layer in East Asia” by Takuma Miyakawa et al.

Takuma Miyakawa et al.

miyakawat@jamstec.go.jp

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Referee #2 Dr. Gavin McMeeking Review of Miyakawa et al.

We appreciate your helpful and constructive comments on the manuscript entitled “Alteration of the microphysical properties of black carbon through transport in the boundary layer in East Asia”. As the two reviewers suggested, we have modified the manuscript. Major points for the revisions are listed as follows. 1) Title has been changed. 2) Supporting information (SI) has been prepared. 3) We have modified the discussion section. *Note the reviewers’ comments in bold.

The authors present a one month case study examining measurements of black car-

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bon properties at a remote island site, using co-located measurements of CO and sub-micron aerosol composition and reanalysis data to evaluate precipitation impacts on the observed properties. The manuscript focuses on contrasting observed properties during periods with differing accumulated precipitation along backward trajectories. The paper is well prepared and well organized and the subject is well within the topic area for ACP. There are several areas where minor revisions are needed, however, before the paper can be recommended for publication. I agree with the points raised by Reviewer #1, so have tried to not repeat too much of what has been already raised. The comments should be addressed in a revised manuscript. In addition: + Given the focus of the manuscript, the introduction would benefit from a more thorough discussion of the various BC removal mechanisms, with more mechanistic details given as to why various processes may or may not be important in the study area. Distinction should be made between in-cloud processes (nucleation scavenging versus scavenging by pre-existing droplets), below-cloud (washout) and dry deposition.

Response> We added the sentence describing the removal processes of BC to the second paragraph of section “Introduction”. Relate to this, as the reviewer #1 suggested, we have modified the descriptions on the relative importance of the washout (to the rainout) (in section 3.3 of the original manuscript). A previous study (Kanaya et al., 2016) is referred for quantitatively elucidating the impacts of dry deposition. The timescale of the removal through the washout was evaluated in this study to be longer than the typical time scale of the transport (details in S.I. newly-prepared). Please see the revised manuscript and SI for more details.

+ Two points regarding reported SP2-measured BC number/mass distributions. First, the manuscript needs to make it more clear when BC core versus shell diameters are being discussed, especially when linking the observations to theory. For example, while it is true we would expect larger particles to be removed in air masses heavily impacted by precipitation, the effects on BC core distributions will be confounded by other material mixed with the cores. Related to this, the diameter range for which the

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optical sizing of the BC particles should be provided in the methods section. Second, small changes in the detection efficiency of the SP2 at its lower limit due to changes in cavity laser power can look like changes in BC core number distribution. A short statement regarding any checks on cavity laser power or other approaches used to ensure consistent behavior at lower size limits for the instrument would be useful.

Response> As the reviewer suggested, we added explanations on these SP2 working conditions in section 2.1. Please see the revised manuscript for more details.

+ Potentially useful additional information provided by the ACSM is being ignored by examining only sulfate. Is there a reason for this?

Response> We analyzed the concentration of SO₄²⁻ measured using the ACSM for the reasons, (1) "its precursor gas (sulfur dioxide) shares the emission sources and locations with CO", and (2) "its formation process in the aqueous phase reaction is useful for analyzing the effect of a possible cloud processing through air parcel transport". We added more explanations especially on (2) to section 2.1.

References Kanaya, Y., X. Pan, T. Miyakawa, Y. Komazaki, F. Taketani, I. Uno, and Y. Kondo (2016), Long-term observations of black carbon mass concentrations at Fukue Island, western Japan, during 2009-2015: Constraining wet removal rates and emission strengths from East Asia, *Atmos. Phys. Chem.*, 16, 10689-10705, doi:10.5194/acp-16-10689-2016, 2016

Please also note the supplement to this comment:

<http://www.atmos-chem-phys-discuss.net/acp-2016-570/acp-2016-570-AC2-supplement.pdf>

Interactive comment on *Atmos. Chem. Phys. Discuss.*, doi:10.5194/acp-2016-570, 2016.