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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Long-term (2001–2012) trends of carbonaceous aerosols from remote island in the western North Pacific: an outflow region of Asian pollutants and dust" *by* Suresh K. R. Boreddy et al.

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Response to anonymous Referee #1 comments

The manuscript titled "Long-term (2001-2012) trends of carbonaceous aerosols from remote island in the western North Pacific: an outflow region of Asian pollutants and dust", is a well written paper. The methodology is sound and data analysis is convincing. The theme of the manuscript is well in accordance with the scope of the journal. The logic was explicit, and the content was comprehensive and integrated. However,

some corrections are still needed before it can be published. Some grammatical errors as well as the wrong use of articles (a/an/the) are found and must be checked before resubmission. Response: We thank the reviewer for careful reading and helpful comments on the manuscript. We revised the manuscript according to the reviewer's comments. Our responses are indicated by the blue color. The changes in the revised manuscript are highlighted with yellow color. Please find the point-by-point responses followed by the revised manuscript. Discussion paper Specific comments: Line 24–25: It would be better to write the abbreviations just after to the name e.g. elemental carbon (EC)... Response: Abbreviated as suggested. Please see lines 23-24 in the revised manuscript (MS).

Line 30: continental polluted air masses Response: Modified as suggested. Please see line 29 in the revised MS.

Line 33: formation of secondary organic aerosols (SOAs) Response: Modified as suggested. Please see line 33 in the revised MS.

Line 35: We found significant increase.... Response: Modified. Please see line 35 in the revised MS.

Line 36: biomass-burning-derived Response: Modified as suggested. Please see line 36 in the revised MS.

Line 37: anthropogenic sources or anthropogenic aerosols? Response: Modified as fossil fuel-derived aerosols in the revised MS. Please see line 37.

Line 38-39: The correlation between OC and MSA- can be shown here to strengthen the sentence. Response: Based on the reviewer's suggestion, we added the following sentence in the revised MS. "This point is further supported by a moderate correlation (r=0.40) between WSOC and MSA- concentrations." Please see lines 40-41 in the revised MS.

Line 40: significant increase in OC/TC and WSOC/TC ratios, Response: Modified

as suggested. Please see line 41 in the revised MS. Line 40-42: Please rephrase the sentence. Response: Rephrased in the revised MS as “We also found significant increase in OC/TC (total carbon) and WSOC/TC ratios, suggesting that the contribution of SOA to carbonaceous aerosols has significantly increased over the western North Pacific via long-range atmospheric transport from East Asian.” Please see lines 41-44 in the revised MS.

Line 42: long-range atmospheric transport? from? Response: Please see above response.

Line 52: There should be a space after “;” in citation bracket throughout the ms e.g. (Zhang and Cao, 2015; Cui et al., 2015). Response: Corrected as suggested in the revised manuscript.

Line 58: “cooling effect” It’s not necessarily always. It would be better to bring the term “brown carbon” also here and simply describe it. Response: We rephrased this sentence in the revised manuscript as “However, the role of OC on cooling or warming has been a matter of debate (Chung et al., 2012; Cazorla et al., 2013) because some class of OC (so called brown carbon) may absorb sunlight (Feng et al., 2013; Lu et al., 2015; Laskin et al., 2015; Bahadur et al., 2012).” Please see lines 62-65 in the revised MS.

Line 60-61: This sentence is a complex one. It can be made simple by describing the above comment. Response: Please see above response.

Line 62: estimation of net radiative forcing Response: Modified as suggested. Please see line 66 in the revised MS.

Line 65: It would be better to write “radiative balance” in place of “climate”. Response: Written as suggested. Please see line 68 in the revised MS.

Line 79: However, there is still large uncertainties exist in quantification of radiative impacts for carbonaceous aerosols.... Response: Modified as suggested. Please see

lines 83-84 in the revised MS.

Line 88: Expand MEGAN and MOHYCAN Response: Expanded. Please see lines 92-93 in the revised MS.

Line 109: Expand WSOC. It’s the first use of this term here. Response: Expanded. Please see line 116 in the revised MS.

Line 175: Here the zero in ‘H0” can be made subscript “H0”. Response: Corrected. We modified this section and moved some phrases to the supporting information (SI). Please see text S1 in the SI.

Line 189: Why 850 hPa pressure level has been used? Please brief the specific reason, if any? Why not 1000 hPa, as the study includes surface concentrations? 850 hPa level is roughly at 1.5 km, may be higher than the marine boundary layer over western Pacific irrespective of seasons. Have you also studied the seasonal variations in boundary layer height? Line 195-197: Some BT analysis can be added here from literatures Response: Following the reviewer’s comment, we modified this section and Figure 2 by replacing the NCEP wind circulation pattern with air mass backward trajectory analysis and corresponding Figure 2. Please see lines 174-186 and Figure 2 in the revises MS.

Line 204: The study period is 2001-2012, why authors have used the met data 2001-2013 in figure S1? Also the figure S1 is showing the year 2014. Please make it clear to easy go for readers. Response: We modified Figure S1 in the revised manuscript and made consistent in sampling period (i.e., 2001-2012). Please see line 189 in the revised MS and also see Figure S1 in the revised SI. Line 214: All measured species (Fig 3a–c). . .. and then again an increasing peak in autumn. It is suggested to discuss monthly variations instead of combine winter-spring season. Response: Following the reviewer’s comment, we modified the phrase in the revised MS as “All measured species clearly showed winter-to-spring maxima (highest concentration was in March) and summer minima (lowest in July) and then increase towards autumn.” Please see

lines 199-200.

Line 215: The seasonal pattern is found consistent with the typical.... Response: Written as suggested. Please see lines 200-201 in the revised MS.

Line 219: discussed in section 3.1. Response: Modified as suggested. Please see line 205 in the revised MS.

Line 220: The highest concentration was clearly seen in March. It is suggested to discuss monthly variations wrt the figure 3 instead of combine winter-spring season. Response: Modified as "Relatively high monthly average concentrations up to 0.28, 1.13 and 0.59 μg m-3 were observed for EC, OC, and WSOC in March. In contrast, their monthly averages are lower in summer or early autumn months (July or September) with the concentrations of 0.04, 0.58, and 0.20 μg m-3, respectively (Table 1)." Please see lines 206-209 in the revised MS.

Line 225: (Figure 2c) Response: Written as Figure 2 in the revised MS. Please see line 211.

Line 232: were up to seven.... Response: Modified as suggested. Please see line 218 in the revised MS.

Line 233-234: suggested negligible contribution of local anthropogenic emissions as well as long-range influences over.... Response: Modified as suggested. Please see lines 219-220 in the revised MS.

Line 235: was found maximum in summer and minimum.. Response: Modified as suggested. Please see lines 239-240 in the revised MS.

Line 236: suggesting negligible.....No need of insert "a" in between. Response: Based on the second reviewer's comment, we rephrased this line in the revised manuscript. Please see lines 217-220

Line 244: delete "over the sampling sites" Response: Deleted as suggested.

Line 248: "observed in midsummer to early autumn".....also write the name of months may in bracket for easy understanding. Response: Written as suggested. Please see line 251 in the revised MS

Line 248-250: "suggesting an influence of biomass burning emissions from southeast Asian countries via long-range" How it suggests? Is it only an assumption? Otherwise provide some suitable references. Response: This is not assumption. The provided picture (figure 2 in the revised MS), air mass backward trajectory analysis, clearly shows the influence of biomass burning influence from Southeast Asian countries. Considering the reviewer's comment, we added air mass backward trajectory analysis along with modis-derived fire spots and shown as Figure 2 in the revised MS. We also added the following phrases in the revised MS. "This point is consistent with the air mass back trajectory analysis and MODIS-fire count data during summer months (Figure 2), which clearly show that air masses are occasionally coming from Southeast Asia including Indonesia, Malaysia and New Guinea etc., where biomass burning is a common phenomena during summer to early autumn. Biomass burning products were transported to the western North Pacific (Figure 2)." Please see lines 253-258 and Figure 2 in the revised MS.

Line 251-253: No. Figure 2c is not clearly showing dominant flow from SEA. Please maximize the axis scale in Figure 2. Moreover, enhanced BB over SEA is evident in February–April not common in June-August (summer) and Sept–Nov (autumn) as mentioned in this study. It may be only occasional. It is suggested to rephrase the sentences. In addition to the continental Asian outflow, western Pacific Ocean also receives biomass burning emissions from Southeast Asia particularly in spring (late February to mid-April) through westerlies. Ex: Tsay et al. (2016) Satellite-Surface Perspectives of Air Quality and Aerosol-Cloud Effects on the Environment: An Overview of 7-SEAS/BASELInE. Aerosol and Air Quality Research 16, 2581-2602. Lin et al. (2013). An Overview of Regional Experiments on Biomass Burning Aerosols and Related Pollutants in Southeast Asia: From BASE-ASIA and the Dongsha Experiment

to 7-SEAS. Atmos. Environ. 78, 1–19. Huang et al. (2013), Impact assessment of biomass burning on air quality in Southeast and East Asia during BASE-ASIA, Atmospheric Environment, 78, 291 – 302. Response: Please see the above response. Further, we discussed above studies briefly in introduction section. Please see lines 102-104 in the revised MS.

Line 259: an unique Response: Modified as suggested. Please see line 269 in the revised MS.

Line 283: showed clear.....Response: Modified as suggested. Please see lines 306 in the revised MS.

Line 287: EC showed a decreasing order,....continuously increasing.....Response: Modified as suggested. Please see lines 310-311 in the revised MS.

Line 336: not necessarily OC always scatters the radiation. OC form BB mostly absorbs. Rephrase the sentence. Response: Rephrased as suggested as "OC (except for brown carbon) and SO42- particles majorly scatter the solar radiation whereas EC particles strongly absorb the radiation in the atmosphere." Please see lines 377-379 in the revised MS.

Line 338: "extension" changes to "extinction". It is suggested to use this reference. Pani et al. (2016). Radiative effect of springtime biomass-burning aerosols over Northern Indochina during 7-SEAS/BASELInE 2013 campaign. Aerosol Air Qual. Res.16: 2802–2817. Response: Corrected and added a reference as suggested. Please see line 380 in the revised MS.

Line: 341: "OC/EC ratios can be used to understand the relative contributions of scattering or absorbing aerosols in the atmosphere (Ram and Sarin, 2015)." It can be but with much uncertainties and limitations. This is may not be true and enough for a marine boundary layer location where long-range transport of distinct air masses is the possible reason of carbons. OCs in this study may be more scatters only due to

aging process. Response: We rephrased this sentence in the revised MS as "Therefore, although OC has certain uncertainty because of light absorbing brown carbon, the OC/EC ratios can be used to understand the relative contributions of scattering or absorbing aerosols in the atmosphere (Ram and Sarin, 2015)." "In this study, atmospheric aging may be making OC more scatter during long-range transport over the western North Pacific." Please see lines 383-385 and 389-390 in the revised MS.

Line 351: nss-sulfate (nss-SO42-) is a major contributor to the CCN,.....use reference.. Response: Added a reference as suggested. Please see line 409 in the revised MS.

Line 352: also plays an.....Response: Modified as suggested. Please see lines 410 in the revised MS.

Line 371: use "regional radiative balance" instead of "Earth's radiative forcing". Response: Modified as suggested. Please see line 432 in the revised MS.

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2017-288/acp-2017-288-AC1-supplement.pdf

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