

Anonymous Referee #4

The author has made a sincere effort to improvise the manuscript relative to the previous version. However, there is still a scope to correct it grammatically, the tenses and apt usage of phrases. Below are the primary comments both technical and non- technical which the author can address to enhance the quality of the manuscript.

Response: We thank the reviewer for taking the time to review our manuscript.

Page 3 Line 13: It is not clear what high resolution measurements the author is talking, is it about time, space?

Response: The reference was to high time resolution measurements. In the revised manuscript, we revised this sentence to “Accurate information on the physicochemical characteristics of BC can improve our understanding of anthropogenic climate impacts on the TP, but there is still lack of high time resolution measurements on the size and mixing state of BC in this region.”

Page 6 Line 18-19: Section 2.3.1 requires more justification how evaluation of surface flux intensity is an indication of regional transport.

Response: The transport of pollutants was markedly influenced by meteorological parameters, especially wind speed and wind direction. For local emission sources, wind can facilitate the dilution and dispersion of air pollutants. Strong winds obviously favor dispersion whereas weak winds often lead to the accumulation of air pollutants. For regional sources, strong winds can transport pollutants over long distances, and that can lead to high concentrations of pollutants in downwind areas. If regional transport carried large rBC particles due to high winds, then the calculated surface flux intensity would be large. Therefore, in our study, we viewed the surface flux intensity as a measure of the influence of regional transport in South Asia, and more specifically on the Lulang site using ground-based observations. In the revised manuscript, we added the following text to make it clearer: “Generally, strong winds favor the dispersion of air pollutants for local emission sources whereas weak winds lead to accumulation. In contrast, for

regional sources, strong winds can transport pollutants from upwind areas and cause high concentrations of pollutants downwind. Therefore, in this study, we viewed the surface flux intensity as a measure of the influence of regional transport in South Asia, and more specifically on the Lulang site using ground-based observations.”

Page 8 Line 31: Please elaborate few difficulties in obtaining scaling factors

Response: Actually, the difficulties in obtaining scaling factors were discussed in our original manuscript; these include the uncertainties caused by the inherent differences instruments themselves and a lack of BC method intercomparisons. This may have been misunderstanding of our original expression, and in the revised manuscript, we changed the sentence to “Therefore, limitations such as those mentioned above make it difficult to establish scaling factors to reconcile the various BC measurements on the TP to a common standard, and direct comparisons of BC data obtained by different methods can be tenuous.”

Page 9 Line 1: i) “Fig 3 (a-c) shows the diurnal variations of rBC mass. . .” Please specify it as the averaged values over the entire campaign. ii) “PBL height” or “PBL depth”, check and change throughout the manuscript iii) ..wind speed during the (not over the) entire campaign – check grammatical errors.

Response: We revised this sentence in the revised manuscript. It now reads: “Fig. 3 (a–c) shows the diurnal variations of the average rBC mass concentrations, PBL heights, and wind speeds during the campaign.” We also changed all the “PBL depth” to “PBL height” throughout the manuscript.

Line 17: “As shown in Fig. 3 (a–b), the rapid morning increase in rBC was accompanied deepening of the PBL, and therefore, regional transport maybe an important influence on the aerosol populations.” The meaning of this sentence is not clear. Reframe the sentence, and what is aerosol populations?

Response: The “aerosol populations” means different chemical components, such as rBC, organic aerosol, sulfate, nitrate, etc. However, since our study focused on

rBC aerosol, in order to make it more clear, we changed the “aerosol populations” to “rBC particles” in the revised manuscript. We reframed this sentence to “As shown in Fig. 3 (a–b), the rapid morning increases in rBC were accompanied by deepening of the PBL, which suggests the possibility that regional transport had an important influence on rBC particles.”

Line 21: “After sunrise, as the PBL starts to deepen, strengthening thermals lift and eventually break the nighttime inversion, and this can lead to the transport of pollutants to the southeastern TP.” Reframe the sentence, as PBL expansion is one of the important factor, but not the only factor

Response: In the revised manuscript, we revised this expression to “After sunrise, as the PBL starts to deepen, strengthening thermals lift and eventually break up the nighttime inversion. These changes in the atmosphere provide conditions that could support the transport of pollutants to the southeastern TP.”

Line 30: In this sentence, “The decreasing trend in the late morning. . .” this change in rBC can well explained using wind direction. Was there any change in wind direction?

Response: The prevailing wind directions changed from southwest at 07:00–09:00 to northeast at 10:00–12:00. In the revised manuscript, we added the wind direction discussion. It now reads: “The decreasing trend in rBC loadings in the late morning at Lulang is consistent with the continued deepening of the PBL (Fig. 3b) and the strengthening winds from the northeast (see Fig. 2 and Fig. 3c).”

Page 12 Line 13: “Fig. S1 shows that rBC core size distribution was well represented by a mono-modal lognormal fit, which is consistent with previous SP2-based observations made across the globe, including urban, rural, remote areas”. Consistent with respect to what? Can you further elaborate?

Response: We revised this sentence in the revised manuscript. It now reads: “Fig. S1 shows that rBC core size distribution was well represented by a mono-modal lognormal fit. This is consistent with the size distributions constructed from previous SP2-based observations made across the globe, including urban, rural,

and remote areas (e.g., Schwarz et al., 2008a; Liu et al., 2010; McMeeking et al., 2011; Huang et al., 2012; Wang et al., 2014).”

Page 13 Line 1-3: “In contrast, smaller rBC MMDs were found when the polluted air masses came from North India (Cluster #1, 173 nm) or central TP (Cluster #3, 177 nm). Moreover, more aged particles in the plumes tend to be larger than fresher particles from close to the source (Moteki et al., 2007)”. So what is the significance of this? Yes aged particle will grow and will be typically larger than fresh ones... What is the std deviation of these mean value? The stated differences are hard to justify (meaning not significant) without the variation in the mean value?

Response: Here we used the results of cluster analysis as a way of demonstrating that air mass transport histories can affect the size distributions of rBC among different rBC studies. This is because the air masses that originate from different regions can have dissimilar initial rBC size distributions due to their main emission sources, etc. In addition, the rBC core sizes may be changed through coagulation during transport. We added the standard deviation of the mean MMD value for each cluster. We also used t-tests to determine whether there were statistically significant differences in the MMDs from different clusters. In the revised manuscript, we reworked this part. It now reads: “Second, transport histories matter because aging of the particles can affect the size distributions of rBC. Take the cluster analysis as an example: the average rBC MMD was the largest (184 ± 17 nm) when the polluted air masses originated from central Bangladesh (Cluster #2). In contrast, smaller rBC MMDs were found when the polluted air masses came from North India (Cluster #1, 173 ± 26 nm) or the central TP (Cluster #3, 177 ± 19 nm). These air masses originated from different source regions, and they may have had different rBC sizes initially; but the rBC core sizes also may have changed during transport through coagulation. It should be noted that a t-test for the rBC MMDs from different clusters showed that there was a statistically significant difference between Cluster #1 and #2 ($p < 0.01$), but was not significant between Cluster #2 and #3 ($p = 0.09$).”