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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Concentration, temporal variation and sources of black carbon in the Mount Everest region retrieved by real-time observation and simulation" *by* Xintong Chen et al.

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We greatly appreciate the reviewers' valuable and constructive suggestions concerning our manuscript (ID: acp-2018-183). The point-by-point reply to the comments are as follow:

Response to Referee's Comments 4

1. This manuscript present analysis of the high-resolution measurement of black carbon (BC) at Qomolangma (Everest) station of Chinese Academy of Sciences during 15 May 2015 to 31 May 2017, together with model simulations to investigate the possible



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transport mechanisms of BC. Generally, the manuscript is well organized, but many sentences and even paragraphs still need to be clarified or improved. Though I have marked many places in the text, I believe that there are still more problematic phases or sentences to be identified and corrected. I suggest that the whole text should be carefully checked and improved with the help of an English editor.

Author response: Thanks for reviewer's advices, we have very carefully checked the whole text and corrected the problematic phrases or sentences and clarified the explanations marked in the text. Moreover, this manuscript has been edited for proper English language, grammar, punctuation, spelling, and overall style by the highly qualified native English speaking editor at American Journal Experts. We have uploaded the editorial certificate file in the attachment.

2. Some of the explanations are not convincing. For example, in line 182 of page 6, it reads "The valley wind from north in the morning, could bring the short-distance emissions from local cooking or heating to QOMS. BC concentrations appeared two peaks in the morning and after the noon in the monsoon season, which might be owing to the surrounding local emission." Why it occurred in the morning and afternoon in the monsoon season, not other times and in other seasons? It should be clarified to what extent the daily and seasonal values and patterns obtained in this study are influenced by local emissions.

Author response: Thanks for reviewer's kind suggestion. We have checked the Section 3.1.3 (Diurnal variation in BC) and rewrite some explanations in Lines 200-204, 210-213, 222-226, and 317-322. In the pre-monsoon period, the BC concentrations remained significantly high from midnight to noon and increased gradually after the lowest value at approximately 15:00. Elevated BC concentrations were also observed in the afternoon during the post-monsoon and winter seasons. According to previous studies, the significantly increased BC was closely linked with the strengthened down-valley wind in the afternoon and at night (such as in the pre-monsoon season), which could deliver the trans-Himalayan pollutions to QOMS. The high values of diurnal BC

concentrations from midnight to noon at QOMS were related to down-valley wind transport as well as stable atmosphere in the pre-monsoon season. However, during the monsoon period, the BC concentrations were significantly lower than those during the other seasons but peaked in the morning and in the afternoon, which might due to the local cooking emissions carried by the valley wind from the north. There are several villages located north (approximately 5 km away) of QOMS.

3. Section 3.2 is not well written. What do you want to say through these comparisons?

Author response: Considering the reviewer's suggestions, we have rewritten Section 3.2 in Lines 228-245. In Section 3.2, we hope to better understand the BC loading level and investigate its potential emission sources at QOMS by comparing our results with previous studies at other sites over the TP. The rewritten Section 3.2 is as follow: A previous study have revealed that low BC concentrations in China can be found on the TP, with values of approximately 200-1000 ng/m3 in PM2.1 and 300-1500 ng/m3 in PM9.0 (Xin et al., 2015). To better understand the BC loading level, we compared our results with previous studies from other locations over the TP. As shown in Fig. 1, the BC concentrations at Muztagh Ata and Qilian Shan presented low values, which can be regarded as the background concentration level for inland Asia (Cao et al., 2009; Zhao et al., 2012). In contrast, the BC concentration at Lhasa city was higher than that at other sites on the TP, which was mainly contributed by local fossil fuel combustion (Li et al., 2016b). In addition, under the impact of the long-range transport of anthropogenic emissions from the east and significant dust input from the west, the BC concentration at Qinghai Lake also showed a relatively high value (Li et al., 2013). The BC concentration at Beiluhe was slightly higher than that at Qinghai Lake, mainly from the arid regions in northwestern China in spring and from the southern slope of the Himalayas in winter (Wang et al., 2016). Therefore, the long-range transportation from Central Asia and East Asia contributed greatly to the BC aerosols in the northern TP. For the sites in the central and southeastern regions on the TP (e.g., Nam Co and Ranwu), which are isolated from anthropogenic activities with relatively clean atmospheric envi-





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ronments, the BC concentrations at these two sites were above 130 ng/m3, likely due to the influence of long-range transport from South Asia (Wan et al., 2015; Wang et al., 2016). Compared with the locations on the southern slope of the Himalayas (e.g., NCO-P and Manora Peak), the BC concentration at QOMS was close to that at NCO-P but much lower than that at Manora Peak, which is near the polluted areas in South Asia and largely affected by anthropogenic emissions (Marinoni et al., 2010; Ram et al., 2010). This implies that the combustion emissions from South Asia affect not only the lower latitudes in the vicinity but also the higher latitudes in the Himalayas and the interior of the TP due to long-range transport.

4. The authors should indicate what is new in this study. It seems to me that most of the results are similar to those obtained in previous studies, although different instruments and models might be used in different studies.

Author response: Previous studies of BC in this region were mainly based on the thermal/optical method with a lower time resolution, through the quartz filter sampling. And the detailed investigation about diurnal and seasonal variations in BC still lacks in this region. In this study, we have presented the real-time data of BC concentrations from 15 May 2015 to 31 May 2017, which can provide more information in diurnal and seasonal variations as well as pollution events, and help us improve the knowledge about sources and transport mechanisms. In addition to the analysis of fire spots and backward trajectories based on the previous studies, we have also used WRF-Chem model and simulated the specific transport processes during the pollution episodes in different seasons, including the horizontal and vertical transport. That is helpful to clarify the transport mechanisms of trans-Himalayan BC aerosols from South Asia.

5. More corrections and comments are marked in the text.

Author response: Thanks for reviewer's patient and valuable revision. We have corrected the problematic phrases or sentences and clarified the explanations marked in the text. The revised manuscript is uploaded, please find in the supplementary files.

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2018-183/acp-2018-183-AC4-supplement.zip

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