Response to Referee #2's Comments

General Comments

Bioaerosols are a class of atmospheric particles, which are more likely to participate in long-distance transport and be observed in other regions. This manuscript investigated the effects of dust events originating in the Gobi Desert of Asia on the amount and diversity of bioaerosols. In this study, sufficient and comprehensive experimental data was presented to reveal that the number of bacteria and the diversity of the bacterial communities showed remarkable increases during the dust events. Microscopic observations made with DAPI staining and MiSeq sequencing analysis were used to determine the results. In general, this manuscript was well-organized and the main conclusions will help improve the current understanding of bioaerosol dynamics along the transport pathway of Asian dust in China. This manuscript should be published in ACP after a little more discussion and analysis to clarify the details behind the presented results.

Response: We would like to thank the reviewer for his positive comments and suggestions. Those comments and suggestions helped us a lot to improve the quality of this paper. The authors have taken the comments from reviewers seriously and addressed all comments in current revision. Below are our point-by-point responses to those comments.

Specific Comments

Page 5 line 3. The result of Jinan samples should be compared with the result from another bioaerosol campaign (AAQR 18, 1-14, 2018).

Response: We thank the reviewer for helpful suggestions, it is of great importance to explore the difference of the bacterial communities between air samples (or dust samples) and cloud samples (Zhu et al., 2018). In this manuscript, 22 samples from Erenhot (17 samples) and Mongolia (5 samples) were analysed by MiSeq sequencing, while Jinan samples were not yet analysed. In spite of this, the comparison between these 22 samples and cloud samples should be inspirational. In the cloud samples of Mt. Tai (Zhu et al., 2018), the dominant bacterial phylum was *Firmicutes*, whose averaged relative abundance was 80.5%, and *Proteobacteria*, *Bacteroidetes*, *Actinobacteria*, and *Fusobacteria* were the following. While *Bacteroidetes* and *Proteobacteria* were the dominant in these 22 air samples, followed by *Actinobacteria* (Fig. 14). The relative abundance of *Firmicutes* did not exceed 5%, and the phylum *Fusobacteria* was not found in these 22 air samples (Fig. S4).

Original Text Pg.16 Ln.15-19 was deleted: At the class level, *Chloracidobacteria* and *Gemmatimonadetes* in dust samples of Erenhot and non-dust samples of R-DzToUb have higher relative amounts compared with non-dust samples of Erenhot and dust samples of R-DzToUb (Fig. 15). *Cytophagia* in the phylum *Bacteroidetes* shows similar phenomenon. Further, *Bacilli* in non-dust samples of Erenhot shows very low amounts down to the detection limit, whereas its relative amounts in other samples keep stable.

Original Text Pg.17 Ln.7: Furthermore, *Firmicutes* was the predominant phylum in the Gobi Desert. The proportions of this phylum reach as high as 82% in surface sand samples, but it was found in relatively small proportions that did not exceed 5% in the air samples (Fig. 14). It's clear that the bacterial community composition in the air is very different from that in the surface sand or soil.

Amended Text Pg.17 Ln.7: The relative abundance of *Firmicutes* increased slightly in dust samples compared with non-dust samples (Fig. 14). *Firmicutes* was the predominant phylum of surface sand samples in the Gobi Desert of Asia, but not in the Taklamaken Desert (An et al., 2013). The relative abundance of *Firmicutes* could reach as high as 82% in the surface sand samples from the Gobi Desert of Asia (44.3°N, 110.1°E) (An et al., 2013), but it was found in relatively small proportions that did not exceed 5% in all the air samples (Fig. 14). Maki et al. (2016) found that the relative abundance of *Firmicutes* in air samples from the Gobi Desert of Asia (44.2304°N, 105.1700°E) varied greatly, from 15.7 to 40.5% in non-dust samples, and no more than 12% in dust samples. The sequences of *Firmicutes* mainly belonged to the classes *Bacilli* and *Clostridia* in air samples from Tsogt-Ovoo, Mongolia (Maki et al., 2016). While *Bacilli*, *Clostridia* and *Erysipelotrichi* in the phylum *Firmicutes* were found in the air samples from Erenhot (Fig. S5). The averaged relative abundance of *Bacilli* in dust samples from Erenhot was 3.2%, while it is much lower in non-dust samples (Fig. 15). It is worth mentioning that Zhu et al. (2018) found that the averaged relative abundance of *Firmicutes* in cloud samples at Mt. Tai of China was 80.5%. As for the Taklimakan Desert, Puspitasari et al. (2015) analyzed the bacterial diversity in sand dunes and dust aerosol, and the relative abundance of *Firmicutes* in dust aerosol samples was higher than that in surface sand samples, which shows a different pattern comparing to the Gobi Desert of Asia. In conclusion, the bacterial community compositions in the air are different from that in the surface sand or soil, and differ by location and transmitting vector.

Page 9, line 20 – page 10 line 4. The concentrations of PM2.5 increased significantly in Zhangbei during D2, D3 and D7. It seems that Zhangbei was seriously affected by the dust events in Erenhot. But the next part of the paper said that Zhangbei was slightly affected by the dust events based on D6. The authors need to explain it.

Response: During the dust event 'D6', the PM2.5 mass concentrations showed a slight increase, not as heavy as D2, D3 and D7. In addition, the barometric pressure of D6 was relatively stable, but that of D2, D3 and D7 were on the contrary, showing a significant decrease. Thereby, Zhangbei was slightly affected by the dust events during the dust event 'D6'.

Original Text Pg.10 Ln.2: A slight increase in $PM_{2.5}$ mass concentrations was observed during event D6, accompanied by a strong north wind, indicating that Zhangbei was slightly affected by the dust events that occur in Erenhot.

Amended Text Pg.10 Ln.2: A slight increase in $PM_{2.5}$ mass concentrations was observed during the event D6, accompanied by a strong north wind and the relatively stable atmospheric pressure, indicating that Zhangbei was slightly affected by the dust events that occur in Erenhot at that time.

Page10 line 19. The name of the sample should be ER4_12D. Please be sure that all the samples' names are correct.

Response: By following the reviewer's suggestion, we have corrected it throughout the manuscript.

Page14 line6. The analyzed 22 samples were collected in Erenhot or Zhangbei?

Response: The analyzed 22 samples were collected in Erenhot and on the road between Dalanzadgad and Ulaanbaatar (R-DzToUb). The names of the 22 samples can be referred to x-coordinate label of Fig. 11. And detailed sample information can be referred to Table S1 and Table S3.

In Fig. 4. Please clarify the meaning of different colors of the air masses.

Response: The different colors of the trajectories mean the different backward trajectory ending time. The trajectory with red color is the backward trajectory which has the latest ending time. Blue is the next, then green, cyan, purple, yellow.

In Fig.9 and in Fig. 10(a). How the authors get the fitting curves and fitting areas. Please clarify it.

Response: The fitting curves and fitting areas were plotted by R software, and the function stat_smooth (method=lm, level=0.95) in the package 'ggplot2' was used. The fitting curves were calculated by the linear regression method, and the independent variable was sorted before regression. The fitting areas were calculated based on the confidence interval of 95%.