Response to Referee #1's Comments

General Comments

Tang et al., have conducted a large scale and comprehensive campaign with the aim to explain key questions in the nature of long distance aerosol transport. The manuscript documents two major aspects of the aerosol samples: microscopy and molecular biology, through several sampling sites and spanning several dust events. The paper provided valuable findings relating an important process (Asian dust events) which may be applicable to many other similar systems worldwide.

Response: We thank the reviewer for his useful 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

Pg.1, Ln. 22 - I do not understand what "charge capacity" means throughout this paper. I can not find relevant results regarding "charge capacity" and microscopy. Did you mean something like fluorescence intensity, fluorescence concentration (as indicated when referring to some of the figures), or particle counts?

Response: The charge capacity means the ratios of the concentrations of two kinds of fluorescent particles. For example, the charge capacity of yellow fluorescent particles associated with the DAPI-stained bacteria means the ratios of the concentrations of DAPI-stained bacteria to those of yellow fluorescent particles. It can be referred to Figure 10 (a) and (b). In Figure 10, "[Fluorescent particle]/[Yellow particle]" means ratios of the concentrations of three kinds of fluorescent particles to those ('that' has been corrected) of the yellow particles. In order to avoid the reader's misunderstanding, '**the charge capacity**' has been replaced by '**the concentration ratios**' throughout the manuscript.

Original Text Pg.1 Ln.22: Moreover, the charge capacity of yellow fluorescent particles associated with the DAPI-stained bacteria increased from 5.1% ± 6.3% (non-dust samples) to 9.8% ± 6.3% (dust samples).

Amended Text Pg.1 Ln.22: Moreover, the concentration ratios of DAPI-stained bacteria to yellow fluorescent particles increased from 5.1% ± 6.3% (non-dust samples) to 9.8% ± 6.3% (dust samples).

Pg.5, Ln.7 - First mention of MiSeq should have company information (Illumina, CA, USA)

Response: By following the reviewer's suggestion, we have added '(Illumina, CA, USA)' when MiSeq is mentioned at the first time.

Pg.7, Ln.7 - in-text citation style should be "...previously described by Maki et al., (2014)." This should also be changed in other parts of the manuscript.

Response: By following the reviewer's suggestion, it has been corrected throughout the manuscript.

Pg.8, Ln.5 - Suggest changing to "phenol chloroform extraction/ethanol precipitation" for clarity.

Response: Thank the reviewer for helpful suggestions, we have modified it as you suggested.

Pg.8, Ln.6 - in-text citation style should be "Maki et al., (2017)"

Response: We thank the reviewer for the helpful suggestion, and have corrected it.

Pg.8, Ln.10 - Should include the hypervariable region(s) targeted (and the primer used) in the first step of PCR amplification.

Response: "During the first-step PCR amplification, fragments of 16S rRNA gene (which covered the variable region V4) were amplified from the extracted gDNA using the universal bacterial primers 515F (5'-Seq A-TGTGCCAGCMGCCGCGGTAA-3') and 806R (5'-Seq B-GGACTACHVGGGTWTCTAAT-3') (Caporaso et al., 2011), where Seq A and Seq B represent the nucleotide sequences bounded by the primer sets of second-step PCR. Detailed process has been described by Maki et al. (2017)." has been added in '2.4 DNA extraction, sequencing and phylogenetic analysis'.

Pg.8, Ln.12 - This BioProject is not publicly available, it needs to be released.

Response: By following the reviewer's suggestion, the BioProject PRJNA413598 has been released on 2018-03-19.

Pg.9, Ln.16 - Consistency in period symbol: (Att. Bac. Coe.) (Dep. Rat.) (Col. Rat.)

Response: We thank the reviewer for helpful suggestion, the missing dots have been added throughout the manuscript.

Pg.14, Ln.4 - This seems to be a major observation/trend, why do you think this is the case?

Response: The major trend is "greater numbers of bacteria can be contained in a unit of yellow particles during dust events, whereas the black particles displayed the opposite behavior". Yellow particles (organic matter) can serve as nutrient sources for microbes, and favor their survival and long-distance transport. In addition, some dead microbes also emit yellow fluorescence. Therefore, it's reasonable that greater numbers of bacteria can be contained in a unit of yellow particles during dust events. On the contrary, more black particles (black carbon) was contained in a unit of yellow particles during non-dust events compared with dust events. Meanwhile, it is speculated that anthropogenic black carbon emission has a significant increase during non-dust periods comparing with that in dust events. It's worth noting that the mixing of the dust and black carbon during the long-distance transport (Fig. S4). Some researches show that the comparison of dust aerosols and anthropogenic pollutants (such as black carbon) shows a clear distinction of optical and radiative characteristics (Huang et al., 2011; Pu et al., 2015; Wang et al., 2010, 2013, 2014, 2015, 2017). Hence the further assessment of the radiative effects of the mixed-type aerosols is warranted.

Based on the above explanation, the manuscript has been revised as follows:

Original Text Pg.10 Ln.14: Under microscopic observation, the particles stained with DAPI emitted several types of fluorescence, mainly blue, white, yellow, or black fluorescence (Fig. 5). These particles were thus categorized as DAPI-stained bacteria (with diameters < 3 μm), white particles (mineral particles), yellow particles (organic matter) and black particles (black carbon) (Maki et al., 2017).

Amended Text Pg.10 Ln.14: Under microscopic observation, the particles stained with DAPI emitted several types of fluorescence, mainly blue, white, yellow, and black fluorescence (Fig. 5), which were thus categorized as DAPI-stained bacteria (with diameters < 3 μm), white particles (mineral particles), yellow particles (organic matter) and black particles (black carbon), respectively (Maki et al., 2017). There were a lot of yellow particles in dust samples, while black-particle concentrations increased in the samples collected in heavy air pollution days, and the internal and external mixing with dust particles and black carbon were also observed under the microscope (Fig. S4). Some researches show that the dust aerosols and anthropogenic pollutant particles (black carbon) can be clearly distinguished in dependence on optical and radiative characteristics (Bi et al., 2016, 2017; Huang et al., 2011; Pu et al., 2015; Wang et al., 2014, 2015 and 2018). Hence the further assessment of the radiative effects of the mixed-type aerosols should be warranted.

Original Text Pg.13 Ln.1: It is speculated that the yellow particles (organic matter) and the white particles (mineral particles) serve as nutrient sources and shelters for microbes, respectively, and favor their survival and long-distance transport.

Amended Text Pg.13 Ln.1: It is speculated that the yellow particles (organic matter) and the white particles (mineral particles) serve as nutrient and shelters for microbes, respectively, and favor their survival and long-distance transport. Some dead cells and debris of microbes are thought to also emit yellow fluorescence (Liu et al., 2014).

Original Text Pg.13 Ln.11: The ratio of the concentrations of the DAPI-stained bacteria, the black particles and the white particles to those of the yellow particles were considered together with the charge capacity of the yellow particles. The charge capacity of the yellow particles for the DAPI-stained bacteria increased slightly with the concentrations of the yellow particles (Fig. 10a). This result indicates that the yellow particles (organic matter) in the dust may serve as nutrient sources and favor microbial survival, which is also partly confirmed by the micrographs (Fig. 6a, b, c and d). The ratios of the concentrations of the DAPI-stained bacteria, the black particles and the white particles to those of the yellow particles ranged from 5.1% ± 6.3% (non-dust samples) to 9.8% ± 6.3% (dust samples), from 73.6% ± 100.4% (non-dust samples) to 9.0% ± 8.2% (dust samples), and from 2.7% ± 3.3% (non-dust samples) to 3.8% ± 4.1% (dust samples), respectively (Fig. 10b). It is quite clear that the charge capacity of the yellow particles associated with the DAPI-stained bacteria was higher in the dust samples compared with that in the non-dust samples. On the other hand, the charge capacity of the yellow particles associated with the black particles was much lower in the dust samples; thus, greater numbers of bacteria can be contained in a unit of yellow particles during dust events, whereas the black particles displayed the opposite behavior.

Amended Text Pg.13 Ln.11: The concentration ratios of the DAPI-stained bacteria, the black particles and the white particles to the yellow particles were calculated (Fig. 10). The concentration ratios of the DAPI-stained bacteria, the black particles and the white particles to the yellow particles ranged from 5.1% ± 6.3% (non-dust samples) to 9.8% ± 6.3% (dust samples), from 73.6% ± 100.4% (non-dust samples) to 9.0% ± 8.2% (dust samples), and from 2.7% ± 3.3% (non-dust samples) to 3.8% ± 4.1% (dust samples), respectively (Fig. 10b). The concentration ratios of the DAPI-stained bacteria to the yellow particles were much higher in the dust samples than in the non-dust samples, while the concentration ratios of the black particles to the yellow particles significantly decreased in the dust samples in comparison to the non-dust samples. Thus, greater numbers of bacteria can be contained in a unit of yellow particles during dust events, whereas the black particles displayed the opposite behavior. The results indicate that the yellow particles (organic matter) in the dust may serve as nutrient and favor microbial survival and long-distance transport, which was also partly confirmed by the micrographs (Fig. 6a, b, c and d). In contrast, anthropogenic black carbon emission increased significantly during non-dust periods comparing to dust event periods.

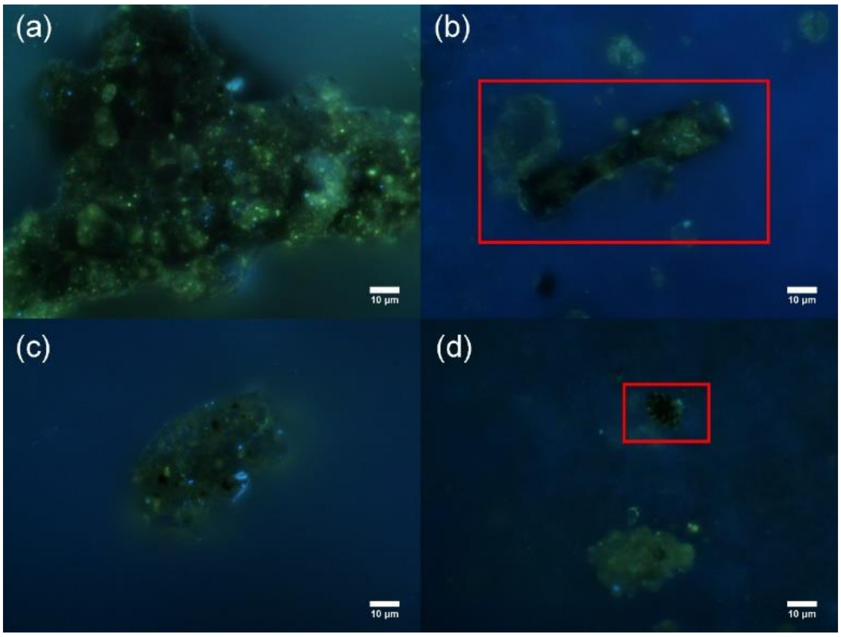

Fig. S4 Epifluorescence micrograph of mixed-type aerosols, (a) from the sample ER4_15D2, (b) and (d) from the sample ER4_11N, (c) from the sample ER4_15N1.

Pg.14, Ln.6 - For reproducibility, please consider uploading the OTU sequences as supplemental files in FASTA format.

Response: By following the reviewer's suggestion, all 16S OTU sequence data has been uploaded in FASTA format.

Pg.15, Ln.21 - Avoid contraction, use "It is"

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

Pg.17, Ln.9 - Avoid contraction, use "It is"

Response: We thank the reviewer for helpful suggestions again, and have corrected it.