Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2016-1095-AC2, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Variations in airborne bacterial communities at high altitudes over the Noto Peninsula (Japan) in response to Asian dust events" *by* Teruya Maki et al.

Teruya Maki et al.

makiteru@se.kanazawa-u.ac.jp

Received and published: 8 August 2017

Dear Anonymous Referee #2:

We thank for admitting the value of our manuscript very much. I take your comments into account in our revised manuscript. I revised our manuscript with paying attention to the points that you commented. I described my response for each your comment. The revised manuscript is attached as supplement file. The sections [Q] indicate your comments and the sections (A) indicate my responses. The changes introduced in the revised manuscript were indicated by the line numbers at the sections (A).

Printer-friendly version

Discussion paper

[Q]1. Introduction: bioaerosols could act as active ice nucleus, consequently affect the microphysical properties of cloud in the atmosphere. Please review some papers about climate effects of bioaerosol, so that the readers are easy to understand the importance of your study.

(A1) The climate effects of bioaerosol has been enhanced using some references in the Introduction section (lines 45-59).

[Q]2. Line 28 in page 3: the authors claimed that aerosols in the two cities directly originate from continental areas. I think it is not rigorous and suitable. There are several sources of aerosols in the Noto Peninsula, such as continental and Ocean area, even from local area, depending on condition of airflows. The word should be changed.

(A2) I agree with this comment. Several sources areas of air-mass transported to Noto Peninsula were explained in the revised manuscript (lines 121-122).

[Q]3. Line 23 in page 4: depolarization ratio is more popular for lidar community that depolarization rates. Please replace it throughout the manuscript.

(A3) The term "depolarization rates" has been changed to "depolarization ratio" in the revised manuscript (entire revised manuscript).

[Q]4. Line 8 in page 5: add 'number concentration' to the behind of 'aerosol'.

(A4) Thank you for your indication. I have revised this part (lines 195-196).

[Q]5. Line 17 in page 6: change 'dust mineral' to 'mineral dust'.

(A5) As your decision, I have changed the term 'dust mineral' to 'mineral dust' (entire revised manuscript).

[Q]6. Line 7-10 in page 7: the word 'troposphere' is not appropriate in the manuscript, please consider 'tropopause'.

(A6) Thank you for your suggestion. In this section, I have revised to more clear expla-

Printer-friendly version

Discussion paper

nation defining the boundary layers over sampling areas (lines 286-288).

[Q]7. Line 25-29 in page 7: please rewrite and cut the paragraph short, it is not necessary to list so many names of the samples. Perhaps the authors can mark dust samples and non-dust samples in Table 1.

(A7) I also think Table 1 can cover the explanation about sample names. Accordingly, this parts explaining about the sample name have been shortened in the revised manuscript (lines 321-325).

[Q]8. Section 3.3: four types of fluorescence particles, such as white, blue, yellow, or black particles, could be seen from fluorescent microscopy. To make the reader easier understand, the author should explain the methods and basis of classification. For example, why the white particles are indicative of mineral dust and yellow particles are organic matter.

(A8) Although some parts of the DAPI staining theory of each fluorescent particles are unclear, they were tried to be explained in the revised manuscript (lines 188-195).

[Q]9. Section 4.1: I suggest move this sentences to Introduction and Section 3.1. Also, I suggest that rewrite the Section 4, and move some sentences to Introduction.

(A9) I agree to your comments. The previous discussion section included some parts which had to be moved to Introduction. In the revised manuscript, the parts were shortened and move to Introduction and the introduction has been modified (in particular lines 455-459, 517-522).

[Q]10. Line 21 in page 12: combine “Maki et al., 2010” and “Maki et al., 2013” to “Maki et al., 2010 and 2013”.

(A10) Thank you for your suggestion. “Maki et al., 2010” and “Maki et al., 2013” have been combined to “Maki et al., 2010 and 2013” in the revised manuscript (line 551).

[Q]11. Line 32 in page 12: add ‘long-range’ in the front of ‘transported’.

(A11) The term 'long-range' has been moved to the front of 'transported' (line 567).

[Q]12. Figure 1: it is not easy for the readers to understand meaning. Please enlarge four panels of helicopter flight routes and reduce size of the East Asia map. Furthermore, panel (a) can be removed and the location of three cities could be marked in panel (b). N and E should be put at the front of latitude ad longitude, such as 50°N and 120°E.

(A12) The maps in Figure 1 have been improved by depending on your suggestion. Thank you for your comments (Figure 1).

[Q]13. Figure 2: according to the meaning described in the paper, the authors would like to use depolarization ratio of aerosols from lidar measurements, for classifying dust events and non-dust events. But the lidar data as shown in fig. 2 is attenuated backscattering, not depolarization ratio. Same as for the panel (a) in fig. 4 and fig. 5. Please replace the data.

(A13) In the previous manuscript, the data in Figs. 2, 4 and 5 were originated from depolarization ratio, but I showed wrong scale bar and unit. Sorry for causing confusion. The scale bar and unit have been changed to correct ones in the revised manuscript (Figures. 2, 4 and 5). Furthermore, the explanation about depolarization ratio have been also revised for describing that the ratio means the rates of non-spherical aerosols among all particles (lines 162-164).

[Q]14. In my opinion, more bacteria should be observed during dust events comparing the condition during non-dust events. Because mineral dust usually can be long-range transported with bioaerosols. However, concentration of fluorescent particles (especially blue particles) at near surface (ground level) was lower during dust events (as shown in fig. (a) and (b)) than those during non-dust events. Please explain the reason.

(A14) On our opinion, the fluorescent particles (blue particles and others) are mostly similar each other between fig. (a) and (b), because the particle concentration units of x axis for fig. (a) are one order higher that for fig. (b); fig. (a): 106 particles/m3, and fig. (b): 105 particles/m3. However, I think that the reason for the similar concentrations is needed for this paper and should be inserted in the revised manuscript. At this sampling periods, the high amounts of bioaerosols would be transported to high altitudes and have not fall down to ground surfaces. On the other hands, the air mass during non-dust events is thought to including high amounts of local aerosols. Accordingly, the microbial concentrations in non-dust events were higher than those of dust events. This explanation has been inserted in the revised manuscript (lines 479-484).

[Q]15. Figure 3: there are several backward trajectories in each panel, but the authors claimed that these three-day backward trajectories only be obtained at two altitudes (2500m and 1200m). Same as for the panel (c) in fig. 4 and fig. 5. Please explain it.

(A15) Trajectories at two altitudes (2500m and 1200m) were calculated at every hour for 4hr (0hr, 1hr, 2hr, 3hr and 4hr) before the sampling finish time of each sampling periods. Accordingly, there are total 10 trajectories for each panel. This explanation has been inserted in the captions of Figs. 3, 4 and 5 (lines 1005-1006, 1019-1020, 1033-1034).

[Q]16. Figure 5: the title of x-axis in panel (a) should be "March 2015", please change it.

(A16) Sorry. I have changed "March 2014" to "March 2015" (Figure 5).

[Q]17. The results in the paper give us more information about bioaerosols in the atmosphere, especially during dust events. The authors are encouraged to compare their results with others from previous studies. Please summarize similar results from other papers in response to dust events, and then add a table in Section discussion.

(A17) As your comment, more references have been cited and the bacterial communities differed from the data of previous researches was discussed in the revised manuscript (Sections of Introduction and Discussion, Table 2).

Please also note the supplement to this comment:
https://www.atmos-chem-phys-discuss.net/acp-2016-1095/acp-2016-1095-AC2-supplement.pdf

---

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2016-1095, 2017.

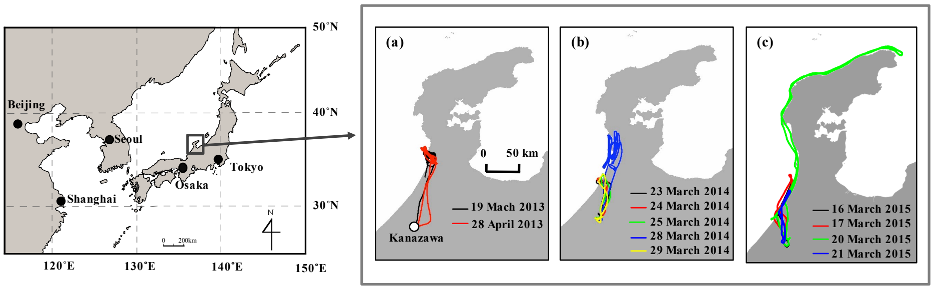

Fig. 1 T. Maki et al.

Fig. 1. Revised Figure 1

Printer-friendly version

Discussion paper

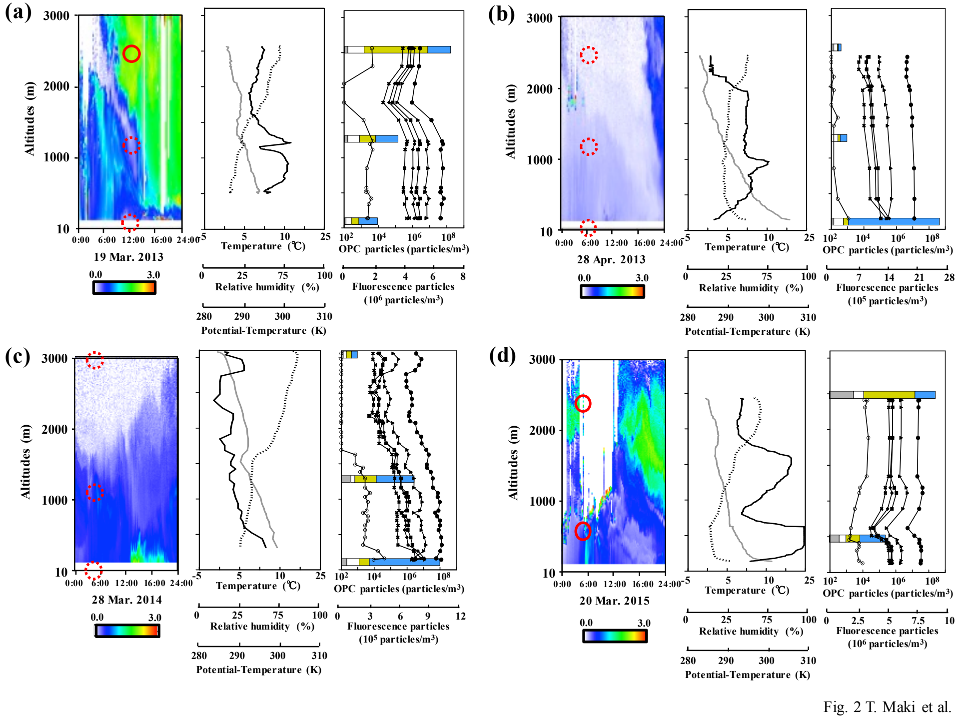

Fig. 2. Revised Figure 2

Printer-friendly version

Discussion paper

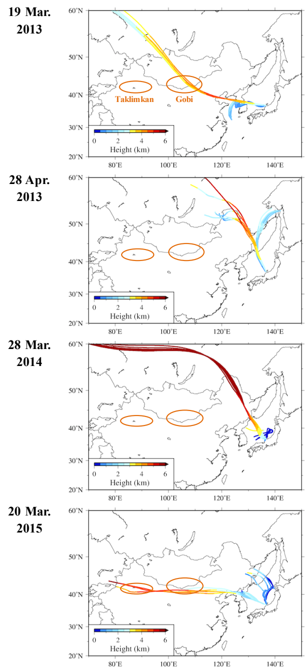

Fig. 3 T.Maki et al.

Fig. 3. Revised Figure 3

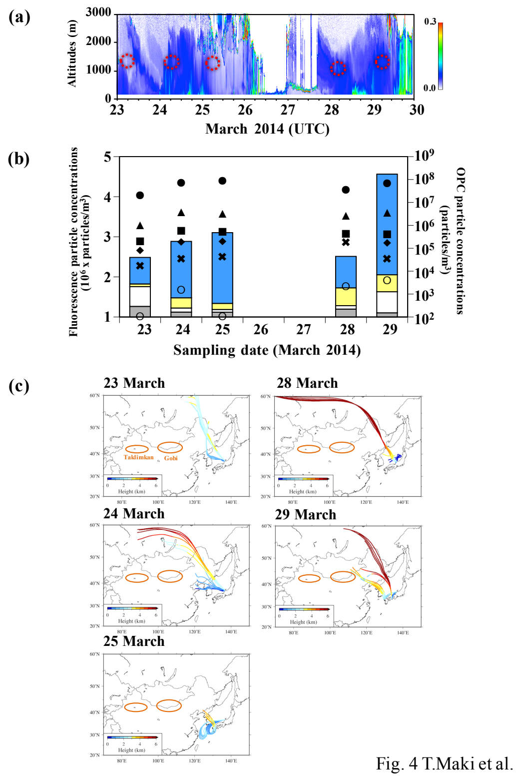

Fig. 4. Revised Figure 4

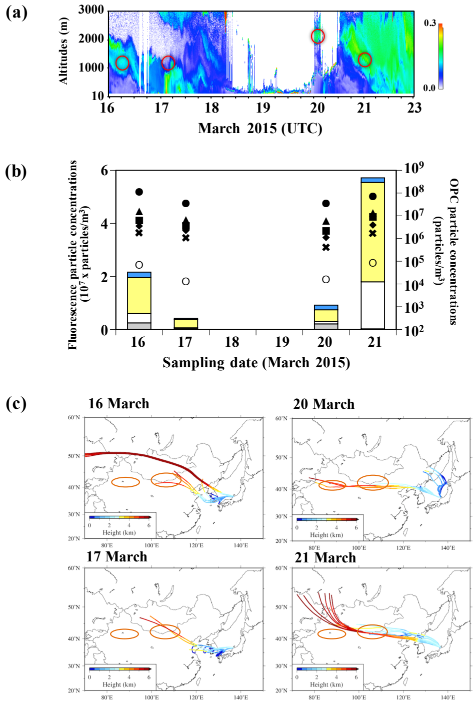

Fig. 5 T.Maki et al.

Fig. 5. Revised Figure 5

Printer-friendly version

Discussion paper

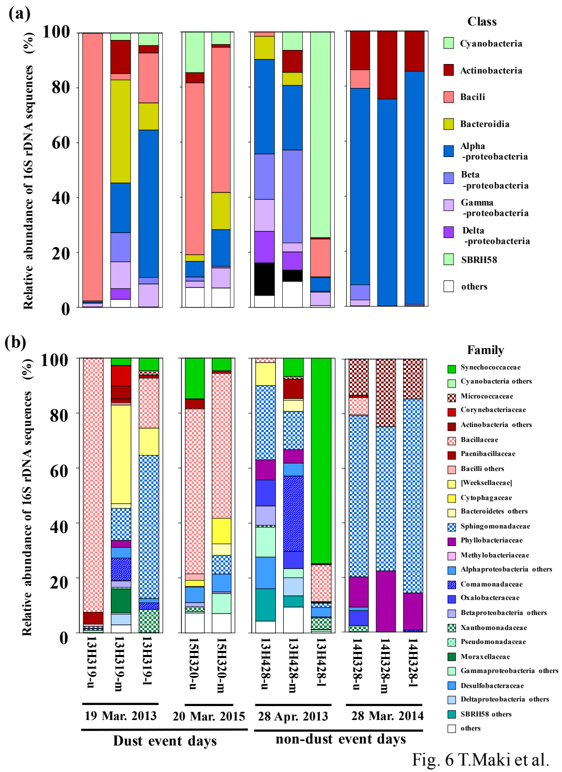

Fig. 6. Revised Figure 6

Printer-friendly version

Discussion paper

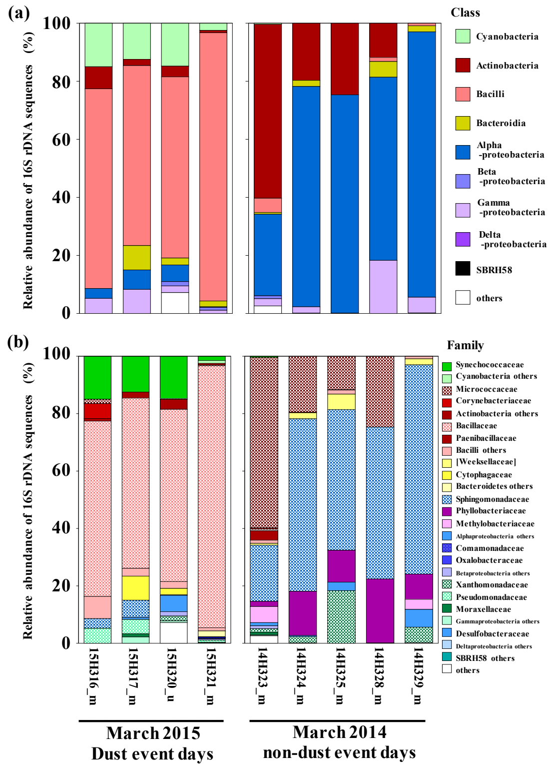

Fig. 7 T.Maki et al.

Fig. 7. Revised Figure 7

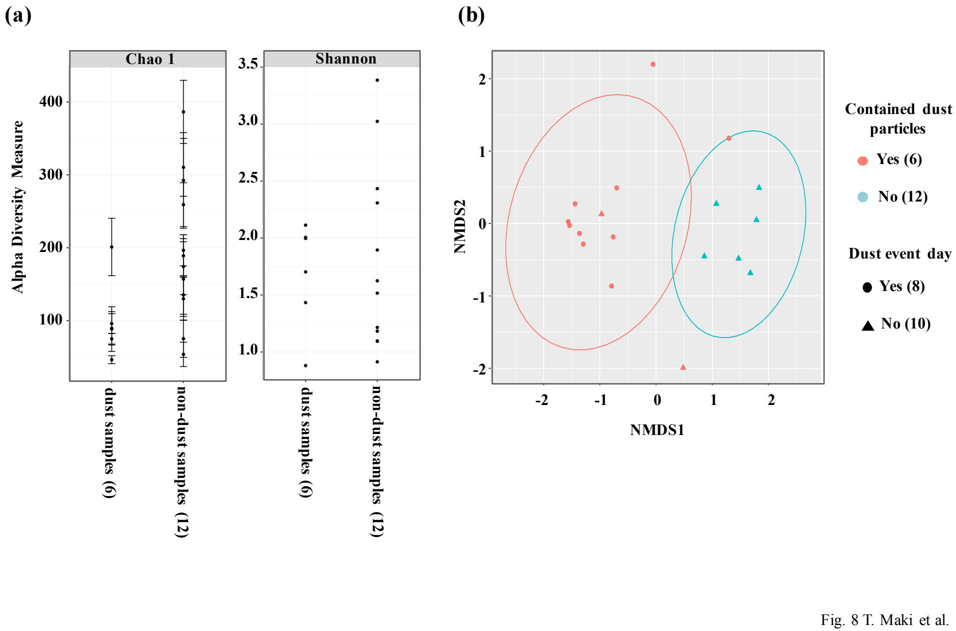

Fig. 8. Revised Figure 8

Table 1 Sampling information during the sampling periods.

Sample name	Sampling date	Collection time (JST)	Total time (min)	Air volume	Sampling method	Sampling location[*1]	Free troposphere[*2]
13H319-u	19 March 2013	14:04 – 15:04	60	700 L	helicopter	2500m	FT
13H319-m		15:19 – 16:19	60	700 L	helicopter	1200m	ABL
13H319-l		14:25 – 15:25	60	700 L	building	10m	GL
13H428-u	28 April 2013	12:10 – 13:04	56	653 L	helicopter	2500m	FT
13H428-m		13:13 – 14:03	50	583 L	helicopter	1200m	ABL
13H428-l		12:03 – 13:03	60	700 L	building	10m	GL
14H328-u	28 March 2014	12:50 – 13:50	60	700 L	helicopter	3000m	FT
14H328-m		14:04 – 15:04	60	700 L	helicopter	1200m	ABL
14H328-l		13:00 – 14:00	60	700 L	building	10m	GL
15H320-u	20 March 2015	12:26 – 13:23	47	548 L	helicopter	2500m	FT
15H320-m		13:39 – 14:40	60	711 L	helicopter	500m	ABL
14H323-m	23 March 2014	10:45 – 11:02	17	11.1 L	helicopter	1200m	ABL
14H324-m	24 March 2014	9:09 – 9:30	21	13.7 L	helicopter	1200m	ABL
14H325-m	25 March 2014	9:31 – 9:50	29	18.9 L	helicopter	1200m	ABL
14H328-m	28 March 2014	14:04 – 15:04	60	700 L	helicopter	1200m	ABL
14H329-m	29 March 2014	9:06 – 9:24	15	9.75 L	helicopter	1200m	PT
15H316-m	16 March 2015	11:21 – 11:43	22	14.3 L	helicopter	1200m	FT
15H317-m	17 March 2015	11:04 – 11:31	27	17.6 L	helicopter	1200m	FT
15H320-u	20 March 2015	12:26 – 13:23	47	548 L	helicopter	2500m	FT
15H321-m	21 March 2015	15:35 – 15:55	20	13.0 L	helicopter	1200m	FT

*1 Height above the ground.

*2 Free troposhere: FT, Atmospheric boundary layer: ABL, Phase transiens: PT, GL: Ground level

Fig. 9. Revised Table 1

Table 2. Researches targeting bacterial communities associated with Asian-dust events

Sampling area*1	Sample	Location	Altitudes (m)	Sampling place	Sampling method	Analytical method for microorganisms	Dominated bacteria*2 1st	Dominated bacteria*2 2nd	Dominated bacteria*2 3rd	references
Dust source area	Soil	Taklamakan Desert, China	0	Ground surface	soil sampling	clone libarary	Bacteroidetes (Sphingobacteriia)	Actinobacteria (Actinobacteria)	Proteobacteria (Alpha, Beta, Gamma)	Yamaguchi et al. 2012
Dust source area	Soil	Gobi Desert, China	0	Ground surface	soil sampling	clone libarary	Actinobacteria (Actinobacteria)	Proteobacteria (Beta)	Bacteroidetes (Sphingobacteriia)	Yamaguchi et al. 2012
Dust source area	Soil	Taklamakan Desert, China	0	Ground surface	soil sampling	pyrosequencing	Firmicutes (Bacilli)†	Actinobacteria	Proteobacteria (Gamma)	An et al. 2013
Dust source area	Soil	Gobi Desert, China	0	Ground surface	soil sampling	pyrosequencing	Firmicutes (Bacilli)†	Proteobacteria (Gamma)	Bacteroidetes	An et al. 2013
Dust source area	Soil	Taklamakan, China	0	Ground surface	soil samples	clone libarary	Actinobacteria (Actinobacteria)	Firmicutes (Bacilli)	Proteobacteria	Puspitasari et al. 2016
Dust source and deposition area	Soil	Loess plateau, China	0	Ground surface	soil sampling	clone libarary	Proteobacteria (Beta, Gamma)	Actinobacteria (Actinobacteria)	Bacteroidetes (Sphingobacteriia)	Yamaguchi et al. 2012
Dust source and deposition area	Soil	Loess plateau, China	0	Ground surface	soil sampling	PCR-DGEE	Proteobacteria	Bacteroidetes	Gemmatimonadetes	Kenzaki et al. 2010
Dust source area	Air	Tsogt-Ovoo, Mongolia	3	Ground surface	filtration	MiSeq sequencing	Proteobacteria (Alpha)	Firmicutes (Bacilli)	Actinobacteria (Actinobacteria)	Maki et al. 2017
Dust source area	Air	Dunhuang, China	10	Top of building	filtration	clone libarary	Firmicutes (Bacilli)†	Proteobacteria	Bacteroidetes	Puspitasari et al. 2016
Dust source area	Air	Dunhuang, China	800	Balloon	filtration	PCR-DGEE	Firmicutes (Bacilli)†	-	-	Maki et al. 2008
Dust source area	Air	Dunhuang, China	800	Balloon	filtration	clone libarary	Proteobacteria (Gamma)	Firmicutes (Bacilli)	-	Kakikawa et al. 2009
Dust deposition area	Air	Noto peninsula, Japan	3000	Aircraft	filtration	clone libarary	Firmicutes (Bacilli)†	Bacteroidetes (Bacteroidia)	Proteobacteria (Gamma)	Maki et al. 2013
Dust deposition area	Air	Noto peninsula, Japan	3000	Aircraft	filtration	MiSeq sequencing	Firmicutes (Bacilli)†	Actinobacteria (Actinobacteria)	Proteobacteria (Alpha&Beta)	Maki et al. 2015
Dust deposition area	Air	Mt. Bachelor Observatory, USA	2700	Mt. Bachelor	filtration	culture	Firmicutes (Bacilli)†	Actinobacteria (Actinobacteria)	Proteobacteria (Gamma)	Smith et al. 2012
Dust deposition area	Air	Mt. Bachelor Observatory, USA	2700	Mt. Bachelor	filtration	Microarray	Proteobacteria (Beta&Gamma)	Actinobacteria (Actinobacteria)	Firmicutes (Bacilli)†	Smith et al. 2013
Dust deposition area	Snow	Mt. Tateyama, Japan	2450	Mt. Tateyama	Snow sampling	PCR-DGEE	Firmicutes (Bacilli)†	Proteobacteria (Beta, Gamma)	Actinobacteria (Actinobacteria)	Tanaka et al. 2011
Dust deposition area	Snow	Mt. Tateyama, Japan	2450	Mt. Tateyama	Snow sampling	PCR-DGEE	Firmicutes (Bacilli)†	Proteobacteria (Beta)	Actinobacteria (Actinobacteria)	Maki et al. 2011
Dust deposition area	Air	Noto peninsula, Japan	1200	Helicopter	filtration	MiSeq sequencing	Firmicutes (Bacilli)†	Proteobacteria (Alpha, Gamma)	Cyanobacteria	This study
Dust deposition area	Air	Suzu, Japan	1000	Balloon	filtration	MiSeq sequencing	Firmicutes (Bacilli)†	Proteobacteria (Alpha)	Deinococcus-Thermus (Deinococci)	Maki et al. 2015
Dust deposition area	Air	Osaka, Japan	900	Air craft	filtration	clone libarary	Firmicutes (Bacilli)	Bacteroidetes (Sphingobacteriia)	Actinobacteria (Actinobacteria)	Yamaguchi et al. 2012
Dust deposition area	Air	Suzu, Japan	800	Balloon	filtration	clone libarary	Firmicutes (Bacilli)†	Bacteroidetes (Bacteroidia)	Proteobacteria (Gamma)	Maki et al. 2013
Dust deposition area	Air	Suzu, Japan	600	Balloon	filtration	PCR-DGEE	Firmicutes (Bacilli)†	-	-	Maki et al. 2010
Dust deposition area	Air	Seoul, South Korea	25	Top of building	liquid impiger	pyrosequencing	Actinobacteria (Actinobacteria)	Proteobacteria (Alpha, Gamma)	Firmicutes (Bacilli)†	Cha et al. 2017
Dust deposition area	Air	Osaka, Japan	20	Top of building	filtration	pyrosequencing	Actinobacteria (Actinobacteria)	Cyanobacteria	Acidobacteria (Acidobacteria)	Park et al. 2016
Dust deposition area	Air	Seoul, South Korea	17	Top of building	filtration	PCR-DGEE	Actinobacteria (Actinobacteria)	Firmicutes (Bacilli)†	Proteobacteria (Gamma)	Lee et al. 2011
Dust deposition area	Air	Beijing, China	15	Top of building	filtration	pyrosequencing	Firmicutes (Bacilli)	Proteobacteria (Gamma)	Bacteroidetes (Flavobacteriia)	Wei et al. 2016
Dust deposition area	Air	Beijing, China	10	Top of building	filtration	HiSeq sequencing	Actinobacteria (Actinobacteria)	Proteobacteria (Alpha, Beta, Gamma)	Chloroflexi (Thermomicrobia)	Cao et al. 2014
Dust deposition area	Air	Seoul, South Korea	10	Top of building	filtration	clone libarary	Firmicutes (Bacilli)†	Actinobacteria	Bacteroidetes	Jeon et al. 2011
Dust deposition area	Air	Suzu, Japan	10	Top of building	filtration	MiSeq sequencing	Firmicutes (Bacilli)†	Deinococcus-Thermus (Deinococci)	Proteobacteria (Alpha)	Maki et al. 2015
Dust deposition area	Air	Goyang, South Korea	-	Top of building	filtration	pyrosequencing	Actinobacteria (Actinobacteria)	Proteobacteria (Gamma)	Firmicutes (Bacilli)†	Cha et al. 2016
Dust deposition area	Air	Kanazawa, Japan	10	Roof of building	filtration	MiSeq sequencing	Firmicutes (Bacilli)†	Cyanobacteria	Proteobacteria (Alpha)	Maki et al. 2014
Dust deposition area	Air	Western Pacific Ocean	-	Ship board	filtration	pyrosequencing	Firmicutes (Bacilli)†	Proteobacteria (Beta, Gamma)	Cyanobacteria	Xia et al. 2015

*1 Dust source area: the areas providing dust mineral particles, Dust deposition area: the area where the dust mineral paticles deposit

*2 The bacterial phyla in the orders of large abundance rates in each samples.

Fig. 10. Revised Table 2

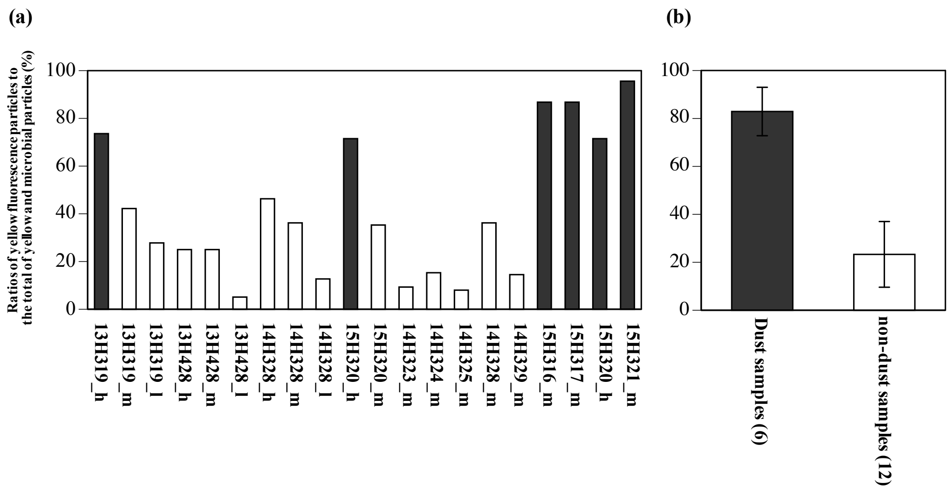

Fig. S4. Ratios of yellow fluorescence particles to the total of yellow and microbial particles. (a) The bioaerosol samples were collected at the three or two altitudes over the Noto Peninsula on 19 March 2013 (LT), 28 April 2013 (LT), 28 March 2014 (LT), and 20 March 2015 (LT) and at the altitudes of 1,200 m (except for the 500 m of 20 March 2015) over the Noto Peninsula from 16 to 23 March in 2015 (LT), and from 23 to 29 March in 2014 (LT). Dust samples and non-dust samples were indicated using black bars and white bars, respectively. (b) The average ratios of Dust samples and non-dust samples.

Fig. 11. Revised Figure S4

Printer-friendly version

Discussion paper