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Interactive comment on "Long-range transported bioaerosols captured in snow cover on Mount Tateyama, Japan: Impacts of Asian-dust events on airborne bacterial dynamics relating to ice-nucleation activities" *by* Teruya Maki et al.

Anonymous Referee #1

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A snow profile which had accumulated during winter and spring was sampled at 2450 m elevation on Mt. Tateyama, Japan. Seventy samples were analysed for ice nucleating particles, fluorescent particles, ion concentrations, and bacterial composition (16S rRNA). Samples from the lower part of the profile were characterised by particles mainly from northern parts of Asia and the Sea of Japan. Samples from the upper part contained larger numbers of particles that originated from the Asian deserts and industrial regions. I find the paper interesting and much of it is well done. At the same time, I would like to see more clarity in certain parts of it. Since I am not a biologist, I

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Discussion paper

can say little about the microbiological part of the study.

1.) Samples were filtered (0.22 micron) and re-suspended for INP quantification. I wonder what proportion of INP may have passed through the filter. Did you do, for comparison, drop freezing assays with samples prior to filtration?

2.) Equation at the end of page 4: What does "deltaMo" stand for? Does "V" stand for the volume of snow from which the particles were derived (e.g. is it corrected for the 200-fold concentration and dilution mentioned in the paragraph above the equation)?

3.) Page 5, line 3: Quantitative statements about ice nucleating particles (INP) should be accompanied by the temperature at which the mentioned INP were active. Otherwise these numbers have little meaning. The numbers (1.74 to 49.7 IN per litre) are very small compared to other numbers of INP in precipitation (please see for comparison the summarising Figure 1 in Petters and Wright, 2015, http://dx.doi.org/10.1002/2015GL065733). Is the unit (IN per litre) correct? Another unit that makes me wonder is the "m-3" on the y-axes of Fig. 4. Should this be "cm-3"?

4.) Page 9, lines 28-29: "Dust mineral particles without organic matters, such as ATD, showed lower temperatures (less than -15 °C) for the initial freezing of water drops than snow samples of the dirty layers." The onset of observed freezing or, as you call it: initial freezing, is a function of the particles' ice nucleation property and the total number of particles in the drop freezing assay. The same kind of particles will show a higher onset of observed freezing when a larger number (higher concentration) of them is tested in an assay (greater probability that it contains a rare INP active at warm temperature). Therefore, parameters like "initial freezing", "end-freezing" and "IN-T50C) are strictly relative numbers. They are meaningful when comparing samples that have all been processed exactly the same. In this context, it would be important to know exactly how the filtration, re-suspension and dilution (page 4, lines 21-24) was done and whether this procedure introduced differences between samples. You write: "Concentrated samples were diluted to the lowest particulate densities of approximately 5.0 ×

10ˆ4 particles mL-1 (from 1.0 μg mL$-$1 to 2.0 μg mL$-$1) using the nano-purewater, . . ." (page 4, lines 23-24). Does that mean you normalised samples to a particle density of 10ˆ4 mlˆ-1 for INP analysis?

5.) Similar to the previous comment about the onset of freezing depending on particle numbers in an assay, the ". . .higher diversity in the dirty snow layers than those of other snow layers. . ." (page 10, lines 8-9) could also result from a greater probability of identifying a rare species in a sample where a larger number of its copies are present (more dirty snow). What is the lowest number of copies of a species that would have been necessary for a species to be detected in your analysis?

6.) By looking at Figure 5a, I wonder why samples with high numbers of INP were not diluted and re-analysed to obtain INP values of all samples for at least one common reference temperature (e.g. -10 C).

Figure 4: Is the unit on the y-axes indeed "m-3"?

Table 1: Some headers and sentences are longer than the text boxes. What is "end-freezing temp."?

Table 2: Header: What do you mean with "Relatives of relative abundances . . ."? Footnotes, **: What do you mean with ". . .the 50% of concentrations of ice nucleic particles."

The manuscript would benefit from English language editing.