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Interactive comment on “Survival and ice nucleation activity of bacteria as aerosols in a cloud simulation chamber” by P. Amato et al.

Anonymous Referee #2

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Summary Amato et al. completed a series of experiments to evaluate the survival rates and ice nucleation behavior of bacterial cells over atmospherically relevant processes, including transport time, cloud formation and sulfate coatings. These experiments were completed in the AIDA chamber; concentrations of colony forming cell units and total cell units were monitored using flow cytometry, while ice nucleation behavior was monitored using an immersion freezing technique. The main findings from this study are: 1. The change in concentration of viable cells due to transport time is described best as an exponential decay. 2. Formation of a convective-like cloud, appears to decrease the abundance of cultivable cells in comparison to the abundance detected in experiments without cloud formation. 3. Non-cultivable cells remain IN active and are still important for consideration as atmospheric INP These findings are interesting, well described

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and relevant to the biological ice nucleation literature. Attention needs to be made to the discussion gap that is currently present when the authors translate the lab results to the complex atmosphere. The following recommendations are suggested to improve the manuscript before publication.

Comments: Page 4059; line 21 – define AIDA right after “AIDA”.

Page 4060; Recommend authors to include an introduction to their experimental approach after introducing the AIDA chamber and to direct the reader to Table 1. It could be as simple as a very brief overview of their experiment types (c, d, and e markers listed in Table 1). Suggest authors rearrange section to include chamber experiment descriptions follow by sampling frequency and SMPS/APS descriptions.

Page 4060; line 8- “For the ageing experiments at constant atmospheric pressure” – what does this mean? Is the aerosolization process not the same for all experiments? Where there experiments for which this spraying/evaporating was not true? Also, could the authors provide a discussion on how the aerosolization process used in this study relates to any hypothesized natural aerosolization processes? Bacteria can be emitted from spray (ocean) but also is often dry generated. The comparison is later made to bacteria released from agricultural fields, yet agricultural emissions are not necessarily release from a spray.

Page 4060; line 10- This sentence is fairly confusing and reads as if evaporation is a mechanism for releasing bacterial cells a dry aerosol state. “were” should be written as “where”. Suggest they rewrite as: “The relative humidity of the chamber was 90 to 95% with respect to ice, thus sprayed droplets evaporated upon entering the chamber. The dried bacterial cell aerosol was then aged for up to 18 hours at the given chamber pressure, temperature and relative humidity, as summarized in Table 1.”

Page 4061; line 4 – “. . .and then saturation with respect to the supercooled liquid droplet phase.” should be “. . .and is saturated with respect to water.”

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Page 4061; line 7 – replace “. . .bacterial cells acted cloud. . .” with “. . .bacterial cells acted as cloud. . .”

Page 4061; line 12 – Please clarify that the chamber was not particle free. Recommend changing “filled with” to “re-pressurized to atmospheric pressure using”.

Page 4061; lines 22- 28 – Recommend including a table to describe different IN activities for these bacterial strains for ease of read.

Page 4062; line 8 – “as described” where? I think they mean “as described in Section 2.4”?

Page 4062; lines 17-19 – The wording here is confusing, suggest authors clarify that the control was impingement liquid placed in the impinger without aerosol sampling.

Page 4063; line 1 – Is this assumption correct? Please provide a reference. Is there a size-dependence to the collection efficiency of the impinger (eg. can the impinger collect a 100 nm particle as efficiently as a 5000 nm particle?)? Please address.

Page 4064; header – should this be INP (rather than IN) assays? Also, please provide a description of how you calculate the error bars presented on Figure 4. Why are some points in Figure 4 without error bars?

Page 4065; Section 3.1 – Interesting results and the translation to an atmospheric perspective is great and useful. However, I think that if these results are presented this way, there should be a discussion on the caveats of the jump that is made from these lab experiments to the complex natural population of atmospheric bacteria. It is important to translate these results to an atmospheric context, but there is a significant amount of discussion that should be included to address how the translation could be invalid. Although the species evaluated in this study were identified in atmospheric samples, the impact of evaporation (during aerosolization process in these experiments), cloud activation, etc could potentially differ depending on the origin of the bacteria. I also recommend the authors to reorganize this section. Suggest having

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subsections for “Time dependent survival rates” and “Impact of cloud processing on cell survival rates” and “atmospheric implications”.

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