

Interactive comment on “Microbiology and atmospheric processes: the role of biological particles in cloud physics” by O. Möhler et al.

O. Möhler et al.

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We acknowledge the comments and questions from the referees and the editor of our paper. Based on that, a revised and certainly improved version of the manuscript will be prepared with less abbreviations, as suggested by the editor. We also appreciate the encouraging comments by Cindy Morris.

In the following sections we respond to the comments from referee #1.

Answers to general remarks:

Primary biological particles: Non-primary particles, those produced due to the action of organisms or chemical transformation of emitted organic compounds, are described in the introduction on page 2561, lines 12–15 of the original manuscript, including key references. The distinction is important because of the abundance of atmospheric

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literature on these 'biogenic' particles.

Concentration units: All concentrations referred to in the manuscript are number concentrations. We have added 'number' in many places, except where the term gets repetitive or the use of units make it obvious. On page 2563, line 12, we have changed 'volume concentration' to 'concentration'.

CCN and supersaturation: What is standard depends on the discipline and in some cases it is necessary to explain principles in terms that are understood by a broader audience. Nevertheless, to be consistent throughout the manuscript, we will use the term 'supersaturation' when referring to CCN activation, but still discuss other processes like the Kelvin effect or hygroscopic growth in terms of relative humidity (RH). The relation between RH and supersaturation is defined on page 2562, line 10.

References: We hope we have covered this to a large extent with our changes. We cannot possibly cover the breadth of ice cloud physics in this overview paper and so we have referenced a few classic texts on the topic.

Answers to specific points:

p 2560, abstract: There are extremely different requirements for most CCN and IN. Any CCN is not an IN. This is discussed in detail in the manuscript.

p 2561, line 21: There is no reference. This statement came from simple considerations of the present knowledge of the vertical distribution of biological particles in the atmosphere and the fact that the additional action of homogeneous ice nucleation processes in these clouds add further (and distracting) complexity to the discussion. We modified the sentence simply to state that we do not treat impacts on cirrus.

p 2562, par. 2: Perhaps it was not clear that we were not necessarily speaking of classical Köhler theory for soluble aerosols. For example, modification of Köhler theory is needed to accurately treat adsorption phenomena on particles that are not soluble. This sentence was a transition into the next part of the paragraph.

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p 2562, last sentence: A key point we wished to make clear was that updrafts and mixing can drive supersaturation and thereby impact the CCN activated. We clarify the moisture content issue.

p 2563, last sentence: We have rewritten it.

p 2564, lines 2-4: We have modified the statement.

p 2564, line 20: We are not sure what the reviewer means by 'numbers'. The impacts of GCCN are discussed in the references provided.

p 2565, top: The meaning of the term was described in response to an earlier comment. We could introduce the meaning of the Kelvin diameter, but this is where reference to standard texts come in.

p 2565, section 4: References will be added.

p 2566, riming and ice splinters: Done. Ice splintering and ice multiplication effects are discussed in the fifth paragraph of this section. We think it is an appropriately placed and worded discussion.

p 2567, line 20: To some people perhaps, but we will replace it.

p 2568, lines 6-24: References will be added.

p 2569, last par.: A description of IN instrumentation is beyond the scope of this paper. We provide a reference.

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