

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

Anonymous Referee #1

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This paper gives a really good overview over what is currently known about the role of biological particles in cloud and ice nucleation processes and formulates research needs for the future. It is comprehensive, interesting, and should certainly be accepted for publication, although a few changes should be made.

In some parts, the MS uses a language that might not be easily accessible to non specialists, so some more explanations and / or more precise language seem to be called for.

Examples:

- Why is there a distinction here between biological particles and primary biological particles? This is not necessary, as the MS is only about bacteria, plant litter and pollen,

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all of which are primary; biological particles, so either explain what the non-primary biological particles are, or simply drop the primary; from the discussion.

- What is meant by ice concentration? Why is the term volume concentration; used (connected with CCN)? In both cases, the term number concentration; should be used. Ice concentration; should be the number concentration of ice particles, and volume concentration; has a different connotation in aerosol science: it is the total particle volume per volume of air.

- CCN activation is discussed both in terms of super-saturation, which is standard usage, and relative humidity, which is not. I would suggest to stick to super-saturation in the discussion.

In several cases, general statements are made (it is well known; etc.) that are not followed by references. I suspect that non-specialist readers might not know these well-known; facts and would appreciate extra information.

There are other points that should be dealt with. I list them in the order of their occurrence.

p 2560, abstract: may be active as both cloud condensation nuclei (CCN) and heterogeneous ice nuclei; why the differentiation? Both CCN and IN are nuclei for heterogeneous condensation

p 2561 line 21: please give reference why biological particles are considered to have a minor effect on cirrus cloud formation

p 2562, par. 2: surface effects on critical super-saturation belong already to classical Köhler theory (the surface tension of the droplet occurs in the Kelvin term). The discussion might indicate otherwise to non-specialist readers.

p 2562, last sentence: Which particles act as CCN for real cloud for-

mation depends both on κ ; and on the dynamics of cloud formation; is easily misunderstood, as the following sentence deals only with how super-saturation is achieved. CCN activation depends on super-saturation. Mixing of air masses with different temperatures will not always result in super-saturation; the water vapour content of the air masses plays an important role.

p 2563, last sentence: should be rewritten for better readability

p 2564, lines 2–4: From the standpoint of contributions to the total number concentration of particles activated;.. bacteria and pollen have some impact; please discuss why the impact is not minor, considering the number concentrations of CCN (>100 / ccm in most environments) and of bacteria (1000 / m^3) (see Pruppacher and Klett)

p 2564, line 20: are more effective; ; could you give numbers also in this text?

p 2565, top: If bacteria and pollen are wettable and therefore start to condense water; could be rewritten

p 2565, 4. Ice formation: please give references for the statements and data in the first two paragraphs

p 2566, riming process: impact freezing of supercooled water droplets on ice crystals should be mentioned

Fracturing of ice crystals should be mentioned somewhere in this section as the reason why IN concentrations are not well related to ice particle concentrations

p 2567, line 20: catalyze; refers to chemical catalysis, not to heterogeneous nucleation

p 2568, lines 6–24: please add references

p 2569, last par: please add references. It would also be nice to have some info on

measuring principles of IN counters

p 2572, par. 2: please add references

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