Dear Gabor and Co-Authors!

The following text is the result of a discussion we had in the Cloud-group at the Institute for Tropospheric Research (TROPOS) in Leipzig, Germany. "We" means, in alphabetical order: Stefanie Augustin-Bauditz, Henner Bieligk, Tina Clauss, Susan Hartmann, Karoliina Ignatius, Ludwig Schenk, Frank Stratmann, Jens Voigtländer and Heike Wex. The text does not reflect the opinion of any single one of us but is a collection to which we all added and on which we all agreed on, in its final form.

Firstly, we would like to thank you for taking the initiative of compiling such a terminology manuscript. This is a vast task, indeed. During the discussion, it already became clear to us that formulating / defining some of these terms is not trivial. Therefore, what follows below is an attempt at trying to convey our ideas which might not always be the same as yours. We understood your manuscript as an invitation to discuss, and here comes our contribution:

page 22157, line 5: embryo
We suggest to also mention “cluster” here.

page 22157, line 11: embryo size
Embryo mass could be mentioned in this definition as well.

page 22158, line 6:
deposition -> deposition nucleation

page 22158, line 6:
Maybe the definitions concerning the ice nucleating entities (particles, macro-molecules, …) could be moved up here, i.e., in front of the definitions concerning the heterogeneous mechanisms.

page 22158, line 13/14: freezing
Generally, we suggest replacing “particle” by “ice nucleating entity (e.g., a particle or macro-molecule)" here. Using "e.g." here leaves the possibility to add additional "ice nucleating entities". As we have learned, ice nucleation/freezing is not only caused by particles (but e.g., also by ice active macro-molecules), and in our view the definition should be broad and open to future surprises.

page 22158, line 17: freezing continued
"cloud" is missing in front of "condensation nucleus (CCN)"

page 22158, line 19: freezing continued
It is clear to us that the term "condensation freezing" is hard to grasp / define, but it seems you tried to somewhat sneak it in at the end of the text. Why not, for the next version of the manuscript, explicitly mention ”condensation freezing” and give its definition(s). Maybe we can decide in the future which one to use.
Furthermore, in line 18, you mention "three" sequences, and it wasn't clear to us if here you refer to deposition ice nucleation and (i) immersion freezing and (ii) contact-freezing, or if the three are immersion, contact and condensation freezing.

page 22158, line 19: substrate

The use of the word "substrate" with respect to ice nucleation was a little unfamiliar and confusing to us. We again think that "entity" or maybe even better “feature” might be the term to use here instead. Of course that depends on what is really meant here (some of us understood you refer to e.g., and INP here, others understood you only meant the location where the ice embryo forms - see our comment to page 22159, line 6). If we consider an ice nucleating particle (INP) to be the substrate, is then the ice nucleating site a feature of that particle? On the other hand, if we consider, e.g., glassy aerosol particles, do they have an ice nucleating feature at all, or are they more like a homogeneous surface with even probability of nucleation? What happens in case of ice nucleating macro-molecules? Are they a substrate, an entity, or a feature? Our suggestion for now: leave out the definition of a substrate, and define ice nucleating entities (e.g. particles, macro-molecules, …) instead. Entities may or may not have ice nucleating features such as cracks, defects, etc.

page 22159, line 3: INP

A small side note first: We understand that INP refers to an insoluble particle better than using the so far often used term of "IN". However, what should e.g. happen to the term IN-chamber and other abbreviations, which have included the term "IN" in the past? (e.g., there are Fast Ice Nucleus Chamber, FINCH, and Portable Ice Nucleus Counter, PINC). Maybe you can comment on that? Thereby, it should be kept in mind that instruments like PINC, CFDC, SPIN, FINCH may count an ice nucleating macro-molecule as INP. Generally, in our opinion this underlines the need for an umbrella term which could be “ice nucleating entity” (INE).

page 22159, line 3: INP, continued

The beginning of the definition "In a very high proportion of cases" is an assessment, which in our view should not appear in a definition and could be removed.

page 22159, line 6: INP, continued

The word "nucleating substrate" caused quite some confusion, by using the word "substrate" here in a different context than before. Here once again the concept of entity (particle, marcro-molecule, …) and feature could be useful.

page 22159, line 25: INxx

The use of "substance" here seems strange as in our view, a crystal or a macro-molecule is not a substance. Once again, “entity” might be an alternative here.

page 22159, line 29: INxx continued

We are currently not aware of a study where a gene really induced freezing. Genes themselves, to our understanding, can lead to the production of proteins, which then, in turn, may function as ice nucleating entities. But this does not really make the gene an ice nucleating gene!? In that manner, we suggest the removal of all references related to genes (also the +/- notation).

page 22160, line 8: nucleation rate

Here "J(t)" (and later on J_v(t) and J_s(t)) are given. Is this a typo and "t" (time) should be "T" (temperature)? It is stated in line 8, that the formula holds for a "collection of identical units", and therefore, in our view the nucleation rate should not change with time, and hence be only

temperature dependent, i.e., "J(T)". Concerning the “specific rate” J_V(t) and J_s(t) (again this should be temperature dependent), please see our comment concerning "nucleation rate coefficient" below.

page 22160, line 15: freezing rate
In our view, the definition you give, i.e., $\boldsymbol{R}(t) = J_V(t) \cdot V$ corresponds to the probability of a single droplet to freeze per unit time (assuming that V is the volume of a single droplet). In that sense, the freezing rate would be $\boldsymbol{R}$, multiplied by the droplet number or number concentration.

page 22161, line 6: site
We suggest defining a site as a feature of an INP where ice nucleation occurs preferentially. However, as assumed in e.g. classical nucleation theory, ice nucleation can occur also on a featureless surface, which might also be mentioned here.

page 22162, line 24: site-specific nucleation
In our view, this paragraph is too long. However before going into this in more detail, agreement concerning the previously treated definitions should be achieved.

Definitions missing in our opinion are:

"Frozen fraction" - This could be as follows: In an ensemble of droplets, this is the number of frozen droplets divided by the number of all droplets.

“Nucleation rate coefficient” or “specific nucleation rate” - This could be as follows:
It is the rate per unit volume of liquid water (homogeneous freezing), or per particle surface area, or per particle mass, or per ice nucleating entity, etc. (heterogenous freezing).
This should be accompanied at least by a statement that the determination of the surface area might be difficult even when considering INP, and is still a topic of research in case of e.g. macro-molecules. We also suggest using lowercase letters (e.g. j) for the specific rates.

Additional remarks:

We suggest to have separated definitions/explanations for the stochastic and singular approaches, giving roughly equivalent treatment to both.

In general, we are not sure if equations have to be or should be used at all, in the definitions. However, if they are used, the definitions of all symbols need to be given in a separate list. And if equations are shown at all, they have to be extended, as some are very simplified at the current state. Furthermore, in case the authors prefer to stay with their “theoretical” formulations (from page 22161, line 10), further discussion in the community is needed and again care has to be taken that singular and stochastic descriptions are treated equally.