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Interactive comment on "Ice nucleation terminology" *by* G. Vali et al.

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Many thanks for the comment, specially for its clear exposition of the difficulties of reconciling the different uses of the term nucleation rate.

The argument is whether the 'old' definition of nucleation rate is to be retained or not. The proposition made in the Terminology is to call "freezing rate" what is called "extensive nucleation rate" in the comment.

The problem arises from an extension of a definition that is valid for homogeneous nucleation to the heterogeneous case. Nucleation rate has a clear meaning for the homogeneous case, and indeed it can be qualified as an extensive variable. There is a large difference between the range of values (temperatures) for empirically significant rates of nucleation between the homogeneous and the heterogeneous cases. It

is a few degrees at most for the homogeneous case, but is nearly 40°C for the heterogeneous case. It is intuitively reasonable and experimentally supported that indeed the probability of freezing on a given heterogeneous site is also small, perhaps only 1°C or so. Therefore, it seems justified to restrict the term nucleation rate in the heterogeneous case to the probability of nucleation on a given site and refer by a new name, freezing rate, to the rate of freezing events in a sample volume. Also, since only one event can be observed in practice in a single volume of water, the extensive rate can only be observed in a sample divided into sub-elements; this too makes use of "freezing rate" more advantageous.

The foregoing arguments were presented in Vali (1994) and in Vali (2008) and have been adopted by some authors. The reason for referring to an 'old' usage in the preceding paragraph is to recall that the origin of the term nucleation rate derives first from condensation observed in a volume of air, and then from initial ideas about freezing in analogy with condensation. The differences in concepts emerged only gradually as the consequences of not being able to observe more than a single freezing event per sample became evident.

One could consider other options than the use of "nucleation rate" and "freezing rate" to cover the processes envisaged. On could refer to the latter as 'embryo formation rate' or 'nucleation probability' or other similar constructs. Clearly, my preference is to stay with the terms given in the Terminology. Improvements in the definitions and explanations will be made. Mention of the extensive nucleation rate concept and its origin in homogeneous nucleation is certainly warranted.

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