Comparison of 17 Ice Nucleation Measurement Techniques for Immersion Freezing

Research Highlight

The majority of ice crystals in mixed-phase clouds (both water and ice) are formed through the immersion freezing mechanism. Increasingly, laboratory experiments have examined this mechanism using a variety of instruments. However, because different ice nucleation (IN) measurement methods have been used to produce these results, comparison of the methods is difficult. In a paper published in **Atmospheric Chemistry and Physics**, researchers, including a scientist from Pacific Northwest National Laboratory, examined the sensitivity and accuracy of these techniques to understand how the IN results are potentially influenced or biased by experimental parameters associated with the techniques.

Within the framework of Ice Nuclei Research Unit, the research team performed immersion freezing experiments using 17 different IN measurement methods to obtain data as a function of particle concentration, temperature (T), cooling rate, and nucleation time. In general, the 17 immersion freezing measurement techniques deviate, within a range of about 8°C in terms of temperature, by three orders of magnitude with respect to active surface site density (ns).

In addition, they show that the immersion freezing efficiency expressed IN in terms of active surface site density of illite-rich particles is relatively independent of droplet size, particle mass in suspension, particle size, and cooling rate during freezing. A strong temperature dependence and weak time and size dependence of the immersion freezing efficiency of illite-rich clay mineral particles enabled the ns parameterization solely as a function of temperature. In their article, the research team provides multiple exponential distribution fits in both linear and log space for both specific surface area-based ns(T) and geometric surface area-based ns(T). These new fits, constrained by using identical reference samples, will help to compare IN measurement methods that are not included in the present study and IN data from future IN instruments.

Reference(s)

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Aerosol Life Cycle