Geophysical Research Abstracts
Vol. 16, EGU2014-8205, 2014
EGU General Assembly 2014

A novel optical freezing array for the examination of cooling rate dependence in heterogeneous ice nucleation

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Homogeneous ice nucleation is a stochastic process, implying that it is not only temperature but also time dependent. For heterogeneous ice nucleation it is still under debate whether there is a significant time dependence or not. In case of minor time dependence it is probably sufficient to use a singular or slightly modified singular approach, which mainly supposes temperature dependence and just small stochastic variations.

We contribute to this discussion using a novel optical freezing array termed BINARY (Bielefeld Ice Nucleation ARraY). The setup consists of an array of microliter-sized droplets on a Peltier cooling stage. The droplets are separated from each other with a polydimethylsiloxane (PDMS) spacer to prevent a Bergeron-Findeisen process, in which the first freezing droplets grow at the expense of the remaining liquid ones due to their vapor pressure differences. An automatic detection of nucleation events is realized optically by the change in brightness during freezing. Different types of ice nucleating agents were tested with the presented setup, e. g. pollen and clay mineral dust. Exemplarily, cooling rate dependent measurements are shown for the heterogeneous ice nucleation induced by Snomax®.

The authors gratefully acknowledge funding by the German Research Foundation (DFG) through the project BIO-CLOUDS (KO 2944/1-1) and through the research unit INUIT (FOR 1525) under KO 2944/2-1. We particularly thank our INUIT partners for fruitful collaboration and sharing of ideas and IN samples.