Immersion freezing describes the process by which an aerosol immersed in a liquid droplet initiates freezing when exposed to low temperatures. There are two hypotheses to describe the process of immersion freezing. The stochastic approach, which states that at a given degree of supercooling, not all particles will initiate freezing at the same time (time-dependent) and the deterministic hypothesis which holds, that at a certain temperature the probability of immersion freezing depends solely on the presence of an active site able to sustain a critical ice embryo at this condition (time independent).

We conducted an experimental study to investigate any compelling reasons for a stochastic or deterministic process of the immersion freezing mechanism. Single, 400 nm kaolinite particles immersed in droplets were exposed to supercooled temperatures in the zurich ice nucleation chamber. The frozen fraction was optically detected consecutively at four different positions of the chamber corresponding to different residence times.

We observed that the frozen fraction increases with residence time of droplets in the chamber. This suggests that there is a time dependence and supports the importance of the stochastic component in immersion freezing.

For the atmosphere (e.g. in mixed-phase clouds) this indicates that the fraction of droplets that freeze, increases with time.

Varying the particle sizes, the investigated temperature range and residence time, will allow a refined interpretation of the results, in particular, the understanding of the contribution of active sites to immersion freezing within the context of the stochastic hypothesis.