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Viability study of ice nucleating active bacteria (*Pseudomonas Syringae*) in freezing cloud droplets

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The plant pathogenic bacteria *Pseudomonas syringae* are capable of inducing ice nucleation at low supercooling due to the presence of INA proteins on the outer cell membrane. Moreover, *P. Syringae* was shown to survive long-range transport in cold airmasses and redeposition to the earth's surface with rain and snow. Thus, the life cycle of *P. syringae* is tightly coupled to the water cycle in the Earth's ecosystem. Understanding the survival mechanism of *P. Syringae* exposed to atmospheric cloud conditions is a prerequisite for characterization of bacteria as atmospheric ice nucleating particles, describing its dissemination paths and potential role in the spread of plant-pathogenic disease.

In this contribution we report on the viability study of ice nucleating active bacteria in freezing cloud droplets. To investigate the bacterial viability, water droplets containing several bacterial cells with low and high concentration of INA proteins are levitated in an electrodynamic balance (EDB) and cooled down to a temperature of -25°C. After freezing, the droplets are extracted from the EDB and the survival probability of the bacteria is determined by colony counting. A fluorescence stain and a high-speed video camera were used to visualize individual bacteria in the levitated droplets and to study their behavior during freezing.

The results have shown that the survival of bacteria depends on the freezing dynamics of bacteria-containing droplets (growth rate of ice in supercooled water). The *P. syringae* bacteria with high concentration of INA proteins are capable of inducing freezing at low supercooling and thus inhibit the growth rate of ice crystals, resulting in higher chance to survive the freezing. If high supercooling is achieved, the ice growth rate immediately after nucleation is very high and the survival probability is dramatically reduced.