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AIDA experiments on heterogeneous ice nucleation in warm mixed-phase clouds

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Clouds are important regulators of the Earth's temperature, because they scatter shortwave radiation from the sun back to space (cooling effect) and absorb long wave terrestrial radiation from the Earth surface (warming effect). About 60% of the Earth's surface is covered with clouds at any time. The response of cloud characteristics and precipitation processes to changing natural and anthropogenic aerosol sources is one of the largest uncertainties in the current understanding of climate change.

Cloud development and precipitation are related to a complex chain of microphysical processes which in many cases starts with the formation of the ice phase. The occurrence and abundance of the ice phase in tropospheric clouds is strongly linked to the freezing properties of cloud droplets and aerosol solution particles as well as the abundance and properties of insoluble aerosol particles which selectively act as heterogeneous ice nuclei. Field and laboratory work have demonstrated that in particular mineral dust and bological particles can act as heterogeneous ice nuclei in mixed-phase clouds. Little is known however about the ice nucleation impact of organic matter, which has been found as a prominent compound of tropospheric aerosol particles and has the potential to form surface coatings to other aerosol particles during their transport through the atmosphere.

The AIDA (Aerosol Interaction and Dynamics in the Atmosphere) facility at the Karlsruhe Institute of Technology has been used to investigate the heterogeneous ice nucleation efficiency of various dust and biological particles. The temperature, pressure and humidity conditions in the cloud chamber can be varied in a wide range of natural cloud systems. This is achieved by expansion cooling induced by strong pumping to the chamber volume. This talk will summarise AIDA experiments and results on the ice nucleation behaviour of bacteria, mineral dust particles, and dust particles coated with sulphuric acid and secondary organic aerosol (SOA) mass from the reaction of alpha-pinene with ozone.