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Ice Nucleation Activity of Various Agricultural Soil Dust Aerosol Particles

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Recent investigations at the cloud simulation chamber AIDA (Aerosol Interactions and Dynamics in the Atmosphere) suggest that agricultural soil dust has an ice nucleation ability that is enhanced up to a factor of 10 compared to desert dust, especially at temperatures above -26 °C (Steinke et al., in preparation for submission). This enhancement might be caused by the contribution of very ice-active biological particles. In addition, soil dust aerosol particles often contain a considerably higher amount of organic matter compared to desert dust particles. To test agricultural soil dust as a source of ice nucleating particles, especially for ice formation in warm clouds, we conducted a series of laboratory measurements with different soil dust samples to extend the existing AIDA dataset.

The AIDA has a volume of 84 m^3 and operates under atmospherically relevant conditions over wide ranges of temperature, pressure and humidity. By controlled adiabatic expansions, the ascent of an air parcel in the troposphere can be simulated. As a supplement to the AIDA facility, we use the INKA (Ice Nucleation Instrument of the KArlsruhe Institute of Technology) continuous flow diffusion chamber based on the design by Rogers (1988) to expose the sampled aerosol particles to a continuously increasing saturation ratio by keeping the aerosol temperature constant. For our experiments, soil dust was dry dispersed into the AIDA vessel. First, fast saturation ratio scans at different temperatures were performed with INKA, sampling soil dust aerosol particles directly from the AIDA vessel. Then, we conducted the AIDA expansion experiment starting at a preset temperature. The combination of these two different methods provides a robust data set on the temperature-dependent ice activity of various agriculture soil dust aerosol particles with a special focus on relatively high temperatures.

In addition, to extend the data set, we investigated the role of biological and organic matter in more detail to gain additional information on the trigger of the enhanced ice nucleation activity of soil dust.

References

Rogers (1988): Development of a continuous flow thermal gradient diffusion chamber for ice nucleation studies

Steinke et al. (In preparation for submission): Ice nucleation activity of agricultural soil dust aerosols from Mongolia, Argentina and Germany