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Separation and sampling of ice nucleation chamber generated ice particles by means of the counterflow virtual impactor technique for the characterization of ambient ice nuclei.

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In 2011, the German research foundation (DFG) research group called Ice Nuclei Research Unit (INUIT (FOR 1525, project STR 453/7-1) was established with the objective to achieve a better understanding concerning heterogeneous ice formation.
The presented work is part of INUIT and aims for a better microphysical and chemical characterization of atmospheric aerosol particles that have the potential to act as ice nuclei (IN). For this purpose a counterflow virtual impactor (Kulkarni et al., 2011) system (IN-PCVI) was developed and characterized in order to separate and collect ice particles generated in the Fast Ice Nucleus Chamber (FINCH; Bundke et al., 2008) and to release their IN for further analysis.
Here the IN-PCVI was used for the inertial separation of the IN counter produced ice particles from smaller drops and interstitial particles. This is realized by a counterflow that matches the FINCH output flow inside the IN-PCVI. The choice of these flows determines the aerodynamic cut-off diameter. The collected ice particles are transferred into the IN-PCVI sample flow where they are completely evaporated in a particle-free and dry carrier air. In this way, the aerosol particles detected as IN by the IN counter can be extracted and distributed to several particle sensors.
This coupled setup FINCH, IN-PCVI and aerosol instrumentation was deployed during the INUIT-JFJ joint measurement field campaign at the research station Jungfraujoch (3580m asl). Downstream of the IN-PCVI, the Aircraft-based Laser Ablation Aerosol Mass Spectrometer (ALABAMA; Brands et al., 2011) was attached for the chemical analysis of the atmospheric IN. Also, number concentration and size distribution of IN were measured online (TROPOS) and IN impactor samples for electron microscopy (TU Darmstadt) were taken. Therefore the IN-PCVI was operated with different flow settings than known from literature (Kulkarni et al., 2011), which required a further characterisation of its cut-off-behaviour. Depending on the operation and thus freezing conditions inside FINCH (temperature/supersaturation), IN number concentrations between 1 and 200 per litre were detected by FINCH and a CPC mounted downstream of the IN-PCVI. The ALABAMA spectra of IN showed organic material from biomass burning and mineral dust particles mixed with organic material. The offline electron microscopy revealed that in average 80% of the IN consist of dust and metal oxides. 20 % are carbonaceous material, of which less than 5 % are soot.

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