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In-situ measurements of ice nucleating particles with FINCH

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Ice nucleating particles (INPs) play an important role of ice and mixed-phase clouds and thus in the formation of precipitation in mid-latitudes. Their abundance and their chemical properties are however, not well understood. The measurement of INPs in ambient air is challenging since their number concentrations are very low.

The number concentration of INPs was determined on-line with the Fast Ice Nucleus CHamber (FINCH; Bundke et al., 2008) at different freezing temperatures and supersaturations. In contrast to other commonly used INP counters, i.e. continuous flow diffusion chambers (CFDCs, Rogers et al., 1988), the supersaturation in FINCH is reached by mixing the sample flow of ambient aerosol with a warm moist and a cold dry airflow. By changing the flow rates and temperatures of the individual airflows the freezing temperature (down to -50°C) and supersaturation (up to above water saturation) can be varied relatively quickly. Particles enter the chamber and grow to crystals if they are ice-active. At the outlet of the chamber a home-built particle counter (FINCH-OPC) detects the number and size of the grown particles (particle size is proportional of the forward scattered light; Bundke et al., 2010). Thus, it can be derived how many of the available particles acted as INPs. Moreover, the autofluorescence of the particles, which are excited with UV light, is detected - providing information whether the INP contained biological material.

During the CLACE/INUIT field campaign in Jan/Feb 2017 at the High Altitude Research Station Jungfraujoch (3580m above MSL, Switzerland) FINCH was operated at two different inlets: (1) A total inlet (operated by PSI) to sample interstitial plus activated aerosol and (2) a total inlet with a Portable Ambient Particle Concentrator (PAPC, operated by University of Toronto) to sample a concentrated flow of interstitial plus active aerosol. FINCH was operated downstream the PAPC during the last five days of the campaign to sample in parallel with the Horizontal Ice Nucleation Chamber HINC (Lacher et al., 2017). The results of INP concentrations show comparable values that have been found before at the Jungfraujoch and are in agreement with INP abundances measured with HINC behind the PAPC.

In a laboratory study at the University Frankfurt, FINCH and the off-line counter FRIDGE (FRankfurt Ice Nuclei Deposition FreezinG Experiment) were operated in parallel, comparing the two techniques. For this study ambient air and test aerosols (e.g. Snomax®) were sampled and ice activity was measured. Results from the field campaign and the laboratory study will be presented.