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Airborne and Ship-based Measurements of Arctic Ice Nucleating Particles (INP) and Cloud Condensation Nuclei (CCN)

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Aerosol particles, acting as Cloud Condensation Nuclei (CCN) and Ice Nucleating Particle (INP), are one of the key factors in understanding and constraining Arctic mixed-phase clouds. However, the relative importance of CCN and INP is not well known, because of the lack of knowledge concerning their abundance, properties, and spatial and vertical distribution.
Here, we present airborne and ship-based measurements of INP and CCN in the Arctic, as measured during the PAMARCMiP campaign, as well as in the framework of the RV Polarstern based PASCAL/SiPCA cruise.
The PAMARCMiP field campaign took place from March to April 2018 around the Villum Research Station (Northern Greenland). The self-built filter sampler HERA was operated onboard the Polar 5 aircraft, while ground-based filter samples were taken with a Digitel Low Volume filter sampler. The INP concentrations were determined with offline filter techniques (analysis of water suspensions from particles collected on filters by the means of immersion freezing experiments on cold stage setups).
From May to July 2017 the PASCAL/SiPCA field campaign took place around and north of Svalbard (up to 84°N, between 0° and 35°E) onboard the RV Polarstern. INP concentrations were measured online with the SPIN instrument (Spectrometer for Ice Nuclei, DMT) and also offline with freezing array techniques from filter samples. By combining these methods, the whole temperature regime relevant for mixed phase clouds is covered. The CCN concentrations were measured with the Cloud Condensation Nucleus Counter (CCNC, DMT) at six different supersaturations.
The contribution of local sources to the INP/CCN population prevailing during these campaigns is assessed by the use of back trajectory modelling together with satellite remote sensing products. For the PASCAL/SiPCA samples, potential sources are additionally investigated by comparing the INP populations from different sources such as the sea surface microlayer, bulk water from a depth of 1 m, and fog.
INP concentrations and freezing onset temperatures vary widely, but were found to be high when we see clear indications for contributions of local sources (terrestrial and marine) to the INP population.

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