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Potential mechanisms for New Particle Formation and growth from aerosol mixing state and volatility observations

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Measurements of ultrafine particle physico-chemical properties in the Arctic region were identified as an important aspect to better understand aerosol-cloud-climate interactions. Atmospheric new particle formation (NPF) is a phenomenon observed in many different environments around the world. Although, the frequency of atmospheric NPF event occurrences is expected to increase in the Arctic region due to sea ice melt (Dall´Osto, et al., 2017), there is only a limited number of studies that focus on nucleation mode particles in this remote environment; current knowledge is limited with respect to the chemical precursors of resulting nanoparticles and the compounds involved in their subsequent growth. Therefore, it is critical to understand the mechanism leading to their role as Cloud Condensation Nuclei (CCN).

Initial steps involved in NPF and subsequent growth are usually clustering and condensation of both organic and inorganic vapors, while ions are also known to be involved in the nucleation process. If newly formed particles are not lost due to coagulation and manage to grow to sizes > 50 nm, they can act as CCN. In particular, NPF have often been observed to be related to sulfuric acid (SA). However, the extent of sulphate production by biogenic sources, including biogenic dimethyl sulfide (DMS) and methanesulfonic acid (MSA), vs. the one due to anthropogenic SO_2 remains an outstanding issue especially in the Arctic troposphere. Biogenic organics in the Arctic Ocean possibly derived from both phytoplankton and terrestrial vegetation could significantly influence the chemical properties of Arctic aerosols (Choi et al., 2019). This coincides very well with MOSAiC's Atmosphere major interdisciplinary focus on–dimethyl sulfide, a gas produced by metabolic processes in algae and other marine microorganisms, and which, as described has a role in complex chemical processes forming aerosols.

Here we present results from one season (May-August) of continuous measurements of particle volatility will be conducted by means of a custom made and well characterized nano-volatility tandem DMA (nano-VTDMA) system installed at Zeppelin station, Ny Aalesund Svalbard. The nano-VTDMA system consists of a medium DMA (M-DMA), a Nano-TD (IAST, Switzerland), a nano-DMA (TSI) and a CPC (TSI, 3776). The nano- VTDMA measurement cycle is typically arranged into three

steps: First, a monodisperse particles fraction will be selected by the first M-DMA; four particle sizes are selected (i.e. 10, 25, 50, 80). Then, the selected particles pass through the thermal denuder (Model NanoTD), operated at four selected temperatures in the range from 30 ^{o}C to 250 ^{o}C. The residual particle number size distribution are measured by the second nano-DMA and the CPC (3776). Parallel DMPS measurements are also examined to identify the NPF events under study

We analyze the observed 12 events identified with fresh particle bursts and we take into account parallel measurements of tracer gases and Black carbon in order to provide the link to natural or anthropogenic emissions. The area of air mass origin is also used as a possible clarification on where these fresh particle originate from.