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Studies of the connection between condensable trace gases and aerosol particles in Svalbard

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In the high Arctic, the climate is warming faster than in the lower latitudes due to the Arctic amplification. Sea ice is melting and permafrost is thawing, and the scarce vegetation of the Arctic is changing rapidly. All these varying conditions will have an impact on possible emission sources of aerosol precursor gases, thus affecting the New Particle Formation (NPF) in the Arctic atmosphere, of which we still know very little. It is important to study the NPF events, which parameters affect the aerosol phase and how these newly formed aerosols can grow into cloud condensation nuclei sizes. Only then, it is possible to understand how climate change is affecting the aerosol population, clouds and regional climate of the pristine Arctic. The role of the precursor gases like Sulphuric Acid (SA), Iodic Acid (IA), Methane Sulphonic Acid (MSA) and Highly Oxygenated organic Molecules (HOM) in NPF in boreal and urban environments has been explored to a great extent. However, the role of these precursor gases in NPF events in remote locations - devoid of pollution sources and the vegetation - is still ambiguous. Therefore, it is crucial to conduct long-term measurements to study the composition and concentrations of aerosol precursors molecules, nanoparticles and air ions in remote and climatically fragile place like Ny-Ålesund in the Arctic. This research location is not only a natural pristine laboratory to understand the atmospheric processes but also acts as a climate mirror reflecting the most drastic changes happening in the atmosphere and cryosphere. In this study, we aim to enhance the understanding of the role of aerosol precursor gases in new particle formation in Ny-Ålesund, Svalbard.

We have studied aerosol particle formation now for almost three years in the Ny-Ålesund research village in Svalbard (78° 55' 24.7368'' N, 11° 54' 35.6220'' E.) with the Neutral cluster and Air Ion Spectrometer (NAIS) measuring ~1-40 nm particles and ions. We have conducted measurements with a Chemical Ionization Atmospheric Pressure interface Time Of Flight (CI-APi-TOF) mass spectrometer to understand the chemical composition of organic precursors vapours and abundance of inorganic aerosol precursor gases such as SA, MSA and IA. Additionally, we have studied the emission and composition of volatile organic compounds on the site during summer-time.

In this study, we report the time series concentrations of the most common aerosol precursor gases like SA, MSA, IA and HOM from the period 28.6.-25.7.2019, which are responsible for the initiation and/or growth of particles. The variability in the concentrations of these vapours

is compared between NPF event and non-event days. The study explores also the role of meteorological parameters like wind speed, wind direction, temperature and humidity on NPF processes.