

New particle formation in boreal forest - effect of SO_2 , NO_x and NH_3 on nucleation from biogenic precursors

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Atmospheric new particle formation is estimated to produce about half of cloud condensation nuclei globally. The chemical and physical processes leading to particle formation and growth are not completely understood, except in simplified laboratory systems. The oxidation products of biogenic volatile organic compounds have been identified as important precursors for new particle formation. However, the particle formation process can be influenced by common anthropogenic pollutants, namely NO_x , SO_2 and NH_3 . We aimed to study the particle formation process under realistic daytime conditions resembling boreal forest atmosphere, in the simultaneous presence of multiple precursor vapors and oxidation pathways.

By performing laboratory experiments in the CLOUD chamber at CERN, we could use atmospherically relevant concentrations of precursors and maintain a high degree of control and a low level of contaminants. We started the particle formation process in the chamber by first adding a mixture of the two most abundant monoterpenes found in the boreal forest, alpha-pinene and delta-3-carene. Then we added different mixing ratios of sulphur dioxide to produce sulphuric acid, nitrogen oxides and ammonia to study their influence on the process. All the experiments were done first in neutral conditions (without ions present) and then repeated with ionization from galactic cosmic rays to study the fraction of ion-induced nucleation. A comprehensive suite of instruments including state-of-the-art particle counters, size spectrometers and mass spectrometers was used to detect the forming particles and their precursors.

We will present results on the interactions between different vapours in particle formation. Especially, we show that oxidized organics, sulfuric acid and ammonia are all needed for replicating the observed nucleation and growth rates, and their variability in the boreal forest environment. We also discuss how NO_x and ions influence the particle formation and growth process from biogenic precursors.