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Volatility of Secondary Organic Aerosols (SOA) from the Ozonolysis of α-Pinene and Limonene

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It has been known for a long time that atmospheric oxidation of organic compounds can lead to formation of low volatility products. These products can be transferred from the gas to the condensed phase, hence giving secondary organic aerosols (SOA). Monoterpenes have been identified as a dominant group of SOA forming compounds. The processes leading to SOA formation are nucleation, i.e. formation of new particles, condensation and gas-to-particle partitioning, i.e. contributing to total mass of SOA. For nucleation and condensation to occur, the concentration of the specific compound must exceed its saturation pressure. The gas-to-particle partitioning on the other hand can occur at concentrations below saturation and is controlled by the chemical potential in the gas-and condensed phase. It is the products with low volatility that undergo direct condensation, whereas compounds with intermediate volatility, i.e. semivolatile compounds, partition from the gas-phase into the condensed phase. The borderline between low and intermediate volatility is not well defined and the information about the characteristics of the volatility of the formed SOA as well as the impact of e.g. reaction temperature, relative humidity and chemical reactions in the condensed phase on the volatility, is inadequate.

The volatility of secondary organic aerosols from the ozone initiated oxidation of α-pinene and limonene has been investigated in a large aerosol chamber facility, the AIDA chamber in Karlsruhe, by using a volatility tandem-DMA system (VTDMA).

This system consists of two DMA:s with a temperature controlled heater in-between. The first DMA separates particles of a certain size and the residual particle number distribution is measured by the second DMA. By monitoring the change in particle peak diameter at different temperatures (298-583K), the volatility of particles can be classified. In this work, the impact of organic precursor, reaction temperature (243-303K), relative humidity (RH), initial size, OH-scavenger and time (i.e. aging up to 30 hours) on volatility have been determined. Additionally, volatility changes are compared to changes in chemical composition, measured by an aerosol mass spectrometer (AMS).