Impact of semi-volatiles on hygroscopic growth and CCN activity of secondary organic aerosol

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Secondary organic aerosols (SOA) are an important constituent of the global aerosol load. They are formed via gas to particle conversion of low- and semi-volatile oxidation products of volatile organic compounds (VOCs) from both biogenic and anthropogenic sources. In smog chamber studies semi-volatile compounds may play an important role. These compounds could be over-represented at the beginning of experiments because of relatively high precursor concentrations and the limited volume of chambers. As an additional complication, these compounds might leave the particle phase when subjected to higher temperatures e.g. in measurement instruments. In this paper we focus on the influence of semi-volatiles on the microphysical properties (i.e. the hygroscopic growth and cloud condensation nuclei (CCN) activity) of SOA. Knowledge of the microphysical properties is important to understand the impact of atmospheric aerosols on climate.

Experiments were conducted in the Manchester Aerosol Chamber (Alfarra et al., 2012) using biogenic (α-pinene, β-caryophyllene, limonene) and anthropogenic precursor VOCs (1,3,5-trimethylbenzene (TMB), n-heptadecane) both individually and in binary or ternary mixtures. In some experiment ammonium sulphate was used as seed aerosol. In order to produce SOA with a range of different composition and properties the oxidation conditions were varied (namely the NO_x to VOC ratio, the starting O_3 concentration, and the spectrum of the UV lamp). All experiments were conducted at approx. 25°C and under humid conditions (RH ~60%).

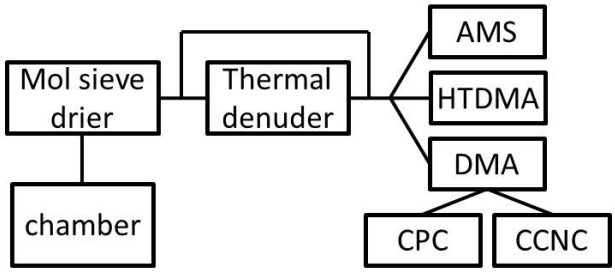

Figure 1. Schematic representation of instrument set up

The aerosol was treated in a thermal denuder (TD) at temperatures between 25 °C (room temperature) and 100 °C to investigate the influence of semi-volatile compounds on the properties of the particles (see Fig. 1). This alternated with sampling directly from the chamber to fully characterise the SOA. The chemical composition was investigated with an Aerodyne Time-of-Flight Aerosol Mass Spectrometer (HR-ToF-AMS). The hygroscopic growth at 90% RH was measured with a hygroscopicity tandem differential mobility analyser (HTDMA). A differential mobility analyser (DMA) was coupled with a CPC to measure the size spectra and with a Droplet Measurement Technology cloud condensation nuclei counter (CCNC).

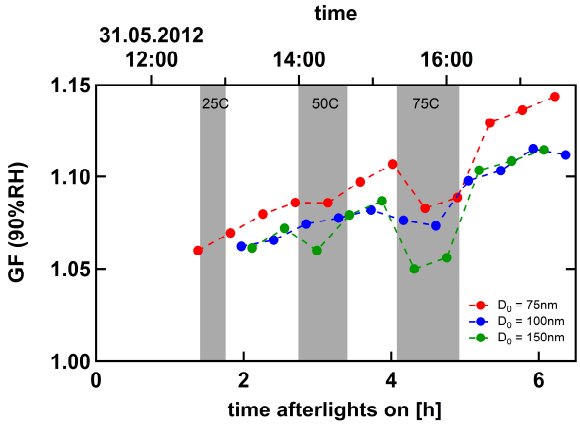

Figure 2. Time series of GF(90%) for an α-pinene experiment.

Figure 2 shows an example for one of the α-pinene experiments. In this case hygroscopic growth was reduced for particles which passed through the TD. A similar effect could be seen for the CCN activity of these particles. We will investigate how the HTDMA and CCNC reconciliation varies with TD temperature and if this can be related to changes in the AMS mass spectra.

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Alfarra et al. (2012), *Atmos. Chem. Phys.*, 12, 6417-6436.