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Aerosol yields from the ozonolysis of α-pinene, limonene and isoprene: Experiments in the aerosol chamber AIDA

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Secondary organic aerosols (SOA) from the oxidation of biogenic volatile organic compounds (BVOC) are a large fraction of the tropospheric aerosol especially over tropical continental regions. The dominant SOA forming compounds are monoterpenes of which α-pinene is the most abundant. The reactions of monoterpenes with OH radicals, NO_3 radicals, and ozone yield secondary organic aerosol mass in highly variable yields. The ozonolysis of monoterpenes is supposed to be one of the major atmospheric sources of SOA. Although isoprene is the most abundant BVOC its contribution to the formation of SOA is still unclear.

Therefore the ozonolysis of α-pinene, limonene, and isoprene has been subject to many recent studies. SOA yields depend mainly on the type of organic precursor molecules, the mass of organic aerosol that can serve as solvent for condensing organic compounds, the acidity of the particulate phase, the humidity, and the temperature controlling the phase equilibrium of the semi volatile organics. So far the influence of temperature on SOA yields is one of the major uncertainties. Therefore we investigated the yield of SOA material from the ozonolysis of α-pinene, limonene, and isoprene under simulated tropospheric conditions in the large aerosol chamber AIDA. Due to its excellent temperature control and large size this chamber enabled us to make experiments on time scales of up to 30 hours and at temperatures between 243 and 313

K. The organic aerosol was generated by controlled oxidation with an excess of ozone and the aerosol yield is calculated from size distributions measured with differential mobility analysers. During the experiments trace gases were measured with PTR-MS, aerosol mass and composition with an aerosol mass spectrometer (AMS) and changes in particle volatility with a volatility tandem differential mobility analyser (VTDMA).

Whereas the aerosol yields depend only weakly on the water concentrations the values increase substantially with decreasing temperature. The aerosol yields increase from 313 K to 243 K by almost one order of magnitude for α-pinene and by a factor of 3 for limonene. The ozonolysis of isoprene alone does not lead to a substantial SOA formation. This paper discusses the aerosol yields as function of temperature, humidity, and organic aerosol mass.