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Temperature dependence of yields of secondary organic aerosols from the ozonolysis of *α*-pinene and limonene

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Abstract. Secondary organic aerosol (SOA) formation has been investigated as a function of temperature and humidity for the ozone-initiated reaction of the two monoterpenes *α*-pinene (243–313 K) and limonene (253–313 K) using the 84.5 m^3 aerosol chamber AIDA. This paper gives an overview of the measurements done and presents parameters specifically useful for aerosol yield calculations. The ozonolysis reaction, selected oxidation products and subsequent aerosol formation were followed using several analytical techniques for both gas and condensed phase characterisation. The effective densities of the SOA were determined by comparing mass and volume size distributions to (1.25±0.10) g cm^{-3} for *α*-pinene and (1.3±0.2) g cm^{-3} for limonene. The detailed aerosol dynamics code COSIMA-SOA proved to be essential for a comprehensive evaluation of the experimental results and for providing parameterisations directly applicable within atmospheric models. The COSIMA-assisted analysis succeeded to reproduce the observed time evolutions of SOA total mass, number and size distributions by adjusting the following properties of two oxidation product proxies: individual yield parameters ($α_i$), partitioning coefficients (K_i), vapour pressures (p_i) and effective accommodation coefficients ($γ_i$). For these properties temperature dependences were derived and parameterised. Vapour pressures and partitioning coefficients followed classical Clausius – Clapeyron temperature dependences. From this relationship enthalpies of vaporisation were derived for the two more and less volatile product proxies of *α*-pinene: (59±8) kJ mol^{-1} and (24±9) kJ mol^{-1}, and limonene: (55±14) kJ mol^{-1} and (25±12) kJ mol^{-1}. The more volatile proxy components had a notably low enthalpy of vaporisation while the less volatile proxy components gave enthalpies of vaporisation comparable with those of typical products from *α*-pinene oxidation, e.g. pinonaldehyde and pinonic acid.

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