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The effect of temperature and water on secondary organic aerosol formation from ozonolysis of limonene, Δ^3-carene and α-pinene

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Abstract. The effect of reaction temperature and how water vapour influences the formation of secondary organic aerosol (SOA) in ozonolysis of limonene, Δ^3-carene and α-pinene, both regarding number and mass of particles, has been investigated by using a laminar flow reactor (G-FROST). Experiments with cyclohexane and 2-butanol as OH scavengers were compared to experiments without any scavenger. The reactions were conducted in the temperature range between 298 and 243 K, and at relative humidities between <10 and 80%. Results showed that there is still a scavenger effect on number and mass concentrations at low temperatures between experiments with and without an addition of an OH scavenger. This shows that the OH chemistry is influencing the SOA formation also at these temperatures. The overall temperature dependence on SOA formation is not as strong as expected from partitioning theory. In some cases there is even a positive temperature dependence that must be related to changes in the chemical mechanism and/or reduced rates of secondary chemistry at low temperatures. The precursor's α-pinene and Δ^3-carene exhibit a similar temperature dependence regarding both number and mass of particles formed, whereas limonene shows a different dependence. The water effect at low temperature could be explained by physical uptake and cluster stabilisation. At higher temperatures, only a physical explanation is not sufficient and the observations are in line with water changing the chemical mechanism or reaction rates. The data presented adds to the understanding of SOA contribution to new particle formation and atmospheric degradation mechanisms.

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