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INFLUENCE OF HUMIDITY ON SOA FORMATION FROM ISOPRENE OXIDATION: EFFECT OF NO_x LEVEL

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A new model for the formation of secondary organic aerosol (SOA) from isoprene was developed. This model uses surrogate molecular species (hydroxy-hydroperoxides, tetrols, methylglyceric acid, organic nitrates) to represent SOA formation. The development of this model used available experimental data on yields and molecular composition of SOA from isoprene and methacrolein oxidation. This model reproduces the amount of particles measured in smog chambers under both low-NO_x and high-NO_x conditions. Under low-NO_x conditions, the model reproduces the transitional formation of hydroxy-hydroperoxides particles, which are photolyzed and lead to SOA mass decrease after reaching a maximum. Under high-NO_x conditions, particles are assumed to be formed mostly from the photo-oxidation of a PAN-type molecule derived from methacrolein (MPAN). This model successfully reproduces the complex NO_x-dependence of isoprene oxidation and suggests a possible yield increase under some high-NO_x conditions. Experimental data correspond to dry conditions (RH $<$ 10 %). However, particles formed from isoprene are expected to be highly hydrophilic, and isoprene oxidation products would likely partition between an aqueous phase and the gas phase at high humidity in the atmosphere. The model was extended to take into account the hydrophilic properties of SOA, which are relevant under atmospheric conditions, and investigate the effect of particulate liquid water on SOA formation. The goal of this study is to investigate the effect of humidity on SOA formation inside chambers and in the atmosphere. Under low-NO_x conditions, an important increase in SOA mass was estimated for humid conditions due to the hydrophilic properties of SOA. However, under high-NO_x conditions, the reverse effect is predicted and this study confirms the decrease of SOA concentrations with increasing humidity which has been observed in smog chambers. Over Europe, low-NO_x conditions prevail, simulations show that isoprene SOA formation increased by taking into account hydrophilic properties and condensation on an aqueous phase. Experiments under high relative humidity conditions and low-NO_x conditions should be conducted to confirm the results of this study, which have implications for SOA modeling.