SOA production from isoprene ozonolysis at low and high RH

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Keywords: Aerosol chemistry, Multiphase chemical processes, Secondary organic aerosol (SOA)

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The formation of secondary organic aerosol (SOA) via reactions occurring in hydrated aerosol and cloud droplets is estimated to be of a similar magnitude to that formed by gas phase reactions (Ervens et al., 2011). However, SOA formation by this pathway is poorly understood so far.

Within the CLOUD (Cosmics Leaving OUtdoor Droplets) project, the formation of SOA from the ozone initiated oxidation of isoprene was investigated. Aerosol growth was studied at high relative humidities (RH ≈ 80 - 95 %) as well as during cloud cycles (droplets were formed by adiabatically reducing chamber pressure); results were compared with measurements performed at an RH of 40%. Experiments were performed at temperatures between -10°C and 10°C, using both acidic (sulfuric acid) and partly to fully neutral (ammonium sulfate) seed aerosol, and varying the mixing ratio of NO₃ in the chamber. Additional experiments without any seed aerosols particles were performed by nucleating and subsequently growing SOA particles. Aerosol growth was measured using a scanning mobility particle sizer (SMPS), and the chemical composition of the particles was studied with a high-resolution aerosol mass spectrometer (HR-AMS). The gas phase composition was determined with a proton transfer reaction time of flight mass spectrometer (PTR-ToF-MS), a chemical ionisation atmospheric pressure interface time of flight (CI-API-TOF) mass spectrometer and trace gas analysers (for NO₃, O₃ and SO₂).

Fig. 1 illustrates the change in dry particle size distribution during a typical experiment. Steady aerosol growth was observed during sub-saturated periods, with more rapid, but partially reversible growth during cloud periods.

Observed SOA yields will be presented for the range of conditions studied, and the mechanisms behind the observed aerosol growth will be discussed, contrasting high and low RH experiments.

Figure 1. Evolution of the dry particle size distribution due to reactive uptake and condensation of isoprene oxidation products within simulated clouds (pink) and during periods with RH < 95 % (grey).

Acknowledgements

We thank CERN for supporting CLOUD. Funded by: EC Seventh Framework Programme (Marie Curie Initial Training Network "CLOUD-ITN" no. 215072, MC-ITN "CLOUD-TRAIN" no. 316662, ERC-Advanced "ATMNUCLE" grant no. 227463), German Federal Ministry of Education and Research (project nos. 01LK0902A, 01LK1222A), Swiss National Science Foundation (project nos. 200020_135307, 206620_130527), Academy of Finland (Center of Excellence project no. 118615), Academy of Finland (135054, 133872, 251427, 139656, 139995, 137749, 141217, 141451), Finnish Funding Agency for Technology and Innovation, Nessling Foundation, Austrian Science Fund (FWF; project no. P19546, L593), Portuguese Foundation for Science and Technology (project no. CERN/FP/116387/2010), Swedish Research Council, Vetenskapsrådet (grant 2011-5120), Presidium of the Russian Academy of Sciences and Russian Foundation for Basic Research (grants 08-02-91006-CERN, 12-02-91522-CERN), and U.S. National Science Foundation (grants AGS1136479, CHE1012293).