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The role of 2-methylglyceric acid and oligomer formation in the multiphase processing of secondary organic aerosol from isoprene and methacrolein photooxidation (CUMULUS project)

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Biogenic volatile organic compounds (BVOCs) undergo atmospheric processing and form a wide range of oxidised and water-soluble compounds. These compounds could partition into atmospheric water droplets, and react within the aqueous phase producing higher molecular weight and less volatile compounds which could remain in the particle phase after water evaporation (Ervens et al., 2011). The aim of this work was the molecular characterisation of secondary organic aerosol (SOA) formed from the photooxidation of isoprene and methacrolein during cloud evapo-condensation cycles. The experiments were performed within the CUMULUS project (CloUd MULtiphase chemistry of organic compoUndS in the troposphere), at the 4.2 m3 stainless steel CESAM chamber at LISA (Brégonzio-Rozier et al., 2016). In each experiment, isoprene or methacrolein was photooxidised with HONO and clouds have been produced to study oxidation processes in a multiphase environment that well simulates the interactions between VOCs, SOA particles and cloud droplets. During all the experiments, SOA was characterised online with a high-resolution time-of-flight aerosol mass spectrometer (HR-ToF-AMS) and offline with gas chromatography mass spectrometry (GC-MS) and direct infusion nanoelectrospray ionisation high resolution mass spectrometry (nanoESI-HRMS). We observed that the main SOA compound in all experiments was 2-methylglyceric acid which undergoes oligomerisation reactions. A large number of long homologous series of oligomers were detected in all experiments, together with a complex co-oligomerised system made of monomers with a large variety of different structures. Comparison of SOA from multiphasic (smog chamber) experiments and samples from aqueous phase oxidation of methacrolein with •OH radical pointed out different types of oligomerisation reactions dominating the two different systems.

Ervens et al. (2011) Atmos. Chem. Phys. 11, 11069 11102.
Brégonzio-Rozier et al. (2016) Atmos. Chem. Phys. 16, 1747 1760.