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# Investigating the processes impacting aerosol composition during the formation and growth of secondary organic aerosol

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Aerosols absorb and scatter solar radiation, influence cloud formation, affect air quality and have adverse effects on human health through respiratory and cardiovascular disorders. Climate and human health effects appear to be directly influenced by chemical speciation of aerosol particles and thus, characterising this is of critical importance. In the atmosphere particles are subjected to reactive transformations, continually changing their size and chemical speciation. Whilst bulk particle measurements using aerosol mass spectrometry have provided step changes in our understanding of aerosol oxidation and ageing, little chemical speciation is provided. Consequently, our knowledge on the physical and chemical changes occurring during aerosol formation, growth and ageing, is limited.

During a series of simulation chamber experiments at the European PhotoReactor (EUPHORE), we have investigated the changes in aerosol composition during the initial SOA growth after nucleation. A particle into liquid sampler at thirty minutes time resolution and off line high-resolution mass spectrometry were used. We have concentrated on the photo-oxidation of two aromatic species, methyl chavicol (biogenic) and toluene (anthropogenic). As seen in previous studies, nucleation occurred when the system entered a relatively low NO state.

In total 59 compounds were identified from methyl chavicol and three distinct temporal profiles were observed. The first showed a slow increase in concentration throughout the four hours after nucleation. The second temporal profile showed a rapid increase in concentration, peaking an hour after nucleation, followed by a very rapid decrease to below the detection limit. The third profile had a similar shape, but the concentration peaked in the sample collected during nucleation. The species that peaked during nucleation and initial aerosol growth were mostly nitrogen containing and structural analysis indicates they are low volatility nitro-aromatics, whose production is controlled by the $NO_2$:NO ratio. The temporal profiles reveal information about the volatility of the oxidation products and highlight the importance of in-particle chemistry and/or gas phase sinks as a loss route for nitro-aromatics. Finally, reactions that retain the aromatic ring, lead to SOA that has both a high O:C ratio and low volatility, mimicking the LV-OOA fraction seen in ambient aerosol.