4.064 Secondary Organic Aerosol from α-Pinene Oxidation at Sub-zero Temperatures: Formation of Extremely Low-Volatility Organic Compounds (ELVOC).

Early Career Scientist

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Abstract:

Extremely low-volatility organic compounds, or ELVOC, are believed to play a crucial role in the formation of particles in the atmosphere (Ehn et al., 2014). In recent years, high molecular weight dimer esters originating from the oxidation of the biogenic volatile organic compound (VOC) α-pinene have been observed in both laboratory-generated and ambient secondary organic aerosol (SOA) (Kristensen et al., 2013). The estimated vapour pressures of the dimer esters classify these as ELVOC, and as recent studies suggest that dimer esters form rapidly through gas-phase reactions, we believe these compounds to be likely candidates involved in new particle formation from oxidation of α-pinene. Furthermore, research shows that the dimer esters only form in the presence of ozone, thus may be used as tracers for ozone-initiated oxidation of α-pinene, and are therefore indicative of enhanced anthropogenic activities.
In the newly constructed cold-room smog chamber at Aarhus University we examine the effects of sub-zero temperatures on the formation of SOA, including dimer esters, from α-pinene oxidation. This state-of-the-art Teflon chamber allows for atmospheric simulations of the oxidation α-pinene and subsequent SOA formation at temperatures down to -16 °C. In experiments involving ozonolysis of α-pinene we observe significantly (up to >4 times) higher particle formation at sub-zero temperature. Furthermore, chemical analysis of the formed particles using liquid chromatography coupled to quadrupole time-of-flight mass spectrometry shows significant differences in the chemical composition related to the experiment temperature. In particular, the concentration of the high molecular weight dimer esters showed to be highly affected. Through this work, we provide new insight into the formation of ELVOC from the oxidation of VOCs and show how changing temperatures may affect not only the formation but also the chemical composition of atmospheric particles.
Ehn, M., *Nature., 506, 476–479, 2014.*

Kristensen, K., *Atmos. Chem. Phys., 13, 3763–3776, 2013.*