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Detection of Gas Phase Oxidation Products of 1,3,5-trimethylbenzene and their Role in Secondary Organic Aerosol Formation

Kevin P. Wyche (1), Timo K. Carr (1), Rebecca L. Cordell (1), Andrew M. Ellis (1), Paul S. Monks (1), Alex E. Parker (1), Christopher Whyte (1), Andrew R. Rickard (2), Urs Baltensperger (3), Jonathan Duplissy (3), Josef Dommen (3), Axel Metzger (3) and Andre S. H. Prevot (3)

(1) Department of Chemistry, University of Leicester, Leicester, UK (kpw5@le.ac.uk / Phone: +44-116-252-5681), (2) Department of Chemistry, University of Leeds, UK, (3) Laboratory of Atmospheric Chemistry, Paul Scherrer Institut, Ch

Many modern atmospheric issues are caused or exacerbated by the presence of airborne particulate matter, including the impairment of local visibility, perturbations to atmospheric chemistry, climate change on the global scale and damaging effects on general population health.

The Secondary Organic Aerosol (SOA) formed in the atmosphere following the oxidation of certain volatile organic compounds (VOCs) constitutes a large proportion of the total mass and number density of the contemporary organic aerosol (Kalberer *et al.*, *Science*, **303**, 1694–1662, 2004). Currently, the formation pathways and chemical composition of SOA are not well characterized: in essence the link between the gas and the aerosol phases is not comprehensively understood. In particular, there exists a distinct lack of detailed knowledge regarding the composition and evolution of the organic gas phase matrix during SOA formation and how the species involved may contribute towards aerosol formation and growth.

In order to explore the “missing link” between the gas and aerosol phases, the University of Leicester Chemical Ionisation Reaction Time-of-Flight Mass Spectrometer (CIR-TOF-MS) was employed to monitor gas phase organics during a series of

SOA formation experiments at the Paul Scherrer Institute Aerosol Chamber. Utilizing H_3O^+ ions to initiate proton transfer to the analyte species, the CIR-TOF-MS was able to successfully monitor in "*real-time*" (*ca.* 1 minute) the majority of the contributing VOCs down to sub-ppbV levels. Standard NO_x, ozone and aerosol measuring instrumentation and a Peroxy Radical Chemical Amplifier (PERCA) were deployed to support VOC measurements. During the study eight comprehensive photooxidation experiments were conducted using 1,3,5-trimethybenzene, a common atmospheric pollutant and known SOA precursor. As part of the study the effect of altering the starting VOC/NO_x ratio was investigated under both high and low NO_x scenarios.

The work presented focuses on the comprehensive VOC and peroxy radical data, recorded by the CIR-TOF-MS and PERCA, along with insightful modeling results obtained using the Master Chemical Mechanism (V3.1). The findings demonstrate the potential role for certain key atmospheric oxidation of anthropogenic origin in the formation of SOA.