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Iain Goodall
United Kingdom (icag1@leicester.ac.uk)

OVOC production from tropospheric alkyne oxidation and contribution to aerosol formation and growth

Iain C. A. Goodall(1)*, Tom Adams(1), Mark Daniels(1), Stephen Ball(1), Paul S. Monks(1) Emanuela Finessi(2), Andrew R. Rickard(3), Maria T. Baeza-Romero(4), Salvatore Peppe(5), Amalia Munoz Cintas(6)
1) Department of Chemistry, University of Leicester, Leicester, LE1 7RH, UK
2) Department of Chemistry, University of York, York, YO10 5DD, UK
3) National Centre for Atmospheric Science (NCAS), University of York, York, YO10 5DD, UK
4) Escuela Ingn Ind Toledo, Toledo 45071, Spain
5) School of Earth and Environment, University of Leeds, Leeds, LS2 9JT, UK
6) EUPHORE Laboratories, Instituto Universitario CEAM-UMH, Valencia, Spain

Ethyne (C2H2) is one of the simplest volatile organic compounds (VOC) and is predominantly emitted via anthropogenic processes and reacts with nitrogen oxides (NO_x) in the presence of sunlight to form tropospheric ozone (O_3). The dominant oxidation product of ethyne is the dicarbonyl species glyoxal (CHOCHO), which is thought to be a significant contributor to secondary organic aerosol (SOA) formation via irreversible oligomerisation reactions upon the surface of hydrated aerosol particulates and within cloud droplets.

A series of chamber experiments were performed at the EUPHORE facility (Valencia, Spain) to study the atmospheric oxidation of ethyne, to determine oxidation product yields and to monitor SOA formation and growth by dicarbonyl oligomerisation. A Proton Transfer Reaction-Time of Flight- Mass Spectrometer (PTR-ToF-MS) was deployed by the University of Leicester to monitor precursor decay and the subsequent evolution of any gas-phase oxidised volatile organic compounds (oVOC). This was further complemented by a Broadband Cavity Enhanced Absorption Spectrometer (BBCEAS) for specific dicarbonyl and NO_2 measurements. Aqueous extracts of chamber SOA were taken from filters collected during the experiments and subsequently analysed offline.

The work explores the yields of low molecular weight products of ethyne oxidation for light and dark reactions, with varying levels of NO_x and OH. Novel experiments were performed under atmospherically relevant conditions utilising natural lighting rather than artificial lighting. Reaction yields have been assessed with the aim of contributing to the ethyne and glyoxal mechanisms in the Master Chemical Mechanism (MCM; http://mcm.leeds.ac.uk/MCM), and have been compared with previously reported values determined from experiments performed under artificial lighting conditions.