

OH, HO₂ and RO₂ Radical and OH Reactivity Observations during the Summertime in Beijing: High In-Situ Ozone Production and Evidence of a Missing OH Source.

Lisa Whalley (1), Eloise Slater (2), Chunxiang Ye (3), Robert Woodward-Massey (2), James Lee (4), Freya Squires (5), James Hopkins (4), Rachel Dunmore (5), Jacqueline Hamilton (5), Alistair Lewis (4), Leigh Crilley (6), Louisa Kramer (6), William Bloss (6), and Dwayne Heard (1)

(1) School of Chemistry, National Centre for Atmospheric Science, University of Leeds, Leeds, United Kingdom (l.k.whalley@leeds.ac.uk), (2) School of Chemistry, University of Leeds, Leeds, United Kingdom, (3) College of Environmental Science and Technology, Peking University, Beijing, China, (4) Department of Chemistry-WACL Building, National Centre for Atmospheric Science, University of York, York, United Kingdom, (5) Department of Chemistry-WACL Building, University of York, York, United Kingdom, (6) School of Geography Earth and Environmental Sciences, University of Birmingham, Birmingham, United Kingdom

Despite substantial reductions in primary emissions of pollutants in China over the past decade, concentrations of the secondary pollutant, ozone, still frequently exceed air quality threshold limits in urban areas during the summertime.

We will present measurements of OH, HO₂ and RO₂ radicals and OH reactivity made in central Beijing at the Institute of Atmospheric Physics of the Chinese Academy of Sciences, close to the North 4th ring road in May and June 2017 which formed the summer phase of 'An Integrated Study of AIR Pollution PROcesses'.

Elevated levels of O₃ (>100 ppbv) were regularly observed. NO concentrations were elevated during the morning but often decreased to below the instrument limit of detection during the afternoon hours when the ozone concentrations peaked. Biogenic emissions influenced the chemistry at the site, with several ppbv of isoprene measured during the afternoons.

The OH measurements were made using the FAGE technique, equipped with an inlet pre injector (IPI) which provides an alternative method to determine the instrument background signal by injecting a scavenger to remove ambient OH and ensures an artefact-free OH measurement. Elevated levels of OH were observed, with a mean peak OH concentration of 1.2×10^7 molecule cm⁻³ at noon; but with OH concentrations reaching up to 2.5×10^7 molecule cm⁻³ on some days. Mean peak HO₂ concentrations of $\sim 3 \times 10^8$ molecule cm⁻³ and total RO₂ of $\sim 1.2 \times 10^9$ molecule cm⁻³ were recorded, with maximum concentrations of 1.0×10^9 molecule cm⁻³ and 4×10^9 molecule cm⁻³ observed for HO₂ and RO₂ respectively, suggesting significant in situ ozone production.

A comparison of the artefact-free OH observations with steady state calculations, constrained to the total OH reactivity measurement and known OH precursors that were measured alongside OH, highlights a significant missing daytime OH source under low [NO], with the steady state OH concentrations approximately a factor of two lower than the OH concentrations observed at noon. The magnitude of this missing OH source is similar to the unexplained OH concentrations reported from other studies in China under low NO conditions as well as studies made in rainforests, implying that the uncertainty in the oxidation chemistry determined from observations in forested regions is relevant to the chemistry in urban regions also.