Constraining Gas Phase Yields and Reactive Uptake Coefficients of Isoprene-OH Oxidation Products onto Acidic Particles by Vocus Ammonia-Adduct Chemical Ionization Mass Spectrometry (Vocus NH4+ CIMS)

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Abstract

Isoprene, the most abundant non-methane volatile organic compound in the atmosphere, undergoes photochemical reactions with OH, a major sink for isoprene, leading to the formation of secondary organic aerosols (SOA). Using Vocus Chemical Ionization Mass Spectrometer CIMS with ammonium-adduct ions (Vocus NH_4^+ CIMS), this presentation provides new insights on the yield and reactive uptake of oxidized volatile organic compounds (OVOCs) produced from isoprene-OH oxidation under dry conditions.

Multiple epoxides that are not the typical isoprene epoxydiols (IEPOX) were identified during the isoprene photooxidation chamber experiments. The molar yields of key oxidation products are quantified with sensitivities estimated from an innovative voltage scan of the front and back end of ion-molecule reactor region of the Vocus. The reactive uptake coefficients (γ) for key isoprene-OH oxidation products onto acidic particles, including non-IEPOX epoxy molecules, are quantified by combining chamber experiments with detailed box modeling. The γ values for $C_5H_{10}O_3$ (IEPOX/ISOPOOH) and $C_5H_8O_4$, an non-IEPOX epoxy molecule, demonstrate rapid decrease as the SOA coating thickness increases, suggesting a self-limiting effect.

Despite ISOPOOH/IEPOX contributing around 80% to total reaction uptake, other oxidation products from isoprene photooxidation, including those non-IEPOX epoxy molecules, still contribute 20% of the total SOA formation. These findings highlight the importance for future models to consider the self-limiting effects of ISOPOOH/IEPOX and SOA formation through non-IEPOX pathways.