

Investigating the Heterogeneous Formation and Degradation of Oligomers in Isoprene Epoxydiol-Derived Secondary Organic Aerosol

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Abstract

Secondary organic aerosol (SOA) is composed of a significant fraction of low-volatility high-molecular-weight oligomer products. These species can affect particle viscosity, morphology, and mixing timescales, yet they are not very well understood. While strides have been made in elucidating oligomer formation mechanisms, their degradation is less studied. Previous work suggests that the presence of oligomers may suppress particle mass loss during atmospheric aging by slowing the production high-volatility fragments from monomers. Our work investigates the effects of relative humidity (RH) on oligomer formation in SOA and the effects of hydroxyl radical ($\cdot\text{OH}$) exposure on oligomer degradation. To probe these questions, SOA is generated by the reactive uptake of isoprene epoxydiols (IEPOX) onto acidic ammonium sulfate aerosol in a 2-m³ steady-state chamber, followed by exposure to $\cdot\text{OH}$ in an oxidation flow reactor. We investigate SOA formation at 30-80% RH, which is above and below the deliquescence point of ammonium sulfate. We examine the evolution of SOA bulk chemical composition as well as single-particle physicochemical properties over the course of aging using mass spectrometry-, spectroscopy-, and microscopy-based techniques. An optimized matrix-assisted laser desorption ionization mass spectrometry (MALDI-MS) method is used to identify and track the presence of oligomers in SOA over the course of aging. Our research will provide insight about the formation and degradation of oligomers in the atmosphere, which will allow better modeling of their impact on climate.