6.182 Enhanced formation of Isoprene-derived Organic Aerosol in Sulfur-rich Power Plant Plumes during Southeast Nexus (SENEX).

Early Career Scientist

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Abstract:

Isoprene is the largest contributor to volatile organic compounds emissions from vegetation. Isoprene epoxydiols (IEPOX), which are oxidation products of isoprene via RO_2 +HO_2 pathway, can reactive uptake to acidic aqueous particles and produce secondary organic aerosol (i.e., denoted as isoprene-OA). Previous ambient measurements have shown a strong association between isoprene-OA and anthropogenic sulfate. However, due to the convoluted relationships between sulfate, particle acidity, and particle water, the mechanisms of the sulfate control on isoprene-OA formation is uncertain. In this study, we investigate the effects of sulfate on isoprene-OA formation through airborne measurements in the southeastern United States as part of the Southeast Nexus (SENEX) field campaign. We sampled downwind from two power plants (i.e., Harllee Branch and Scherer) in Georgia and found that isoprene-OA formation was only enhanced in Harllee Branch plume, but not in Scherer plume. This is because Harllee Branch emitted more sulfur dioxide (SO_2) than Scherer and more aerosol sulfate was produced downwind. The contrast between two power plants provides an opportunity to examine the magnitude and mechanisms of sulfate on isoprene-OA formation. We estimate that 1 μg sm^{-3} decrease in sulfate would decrease isoprene-OA by 0.23±0.08 μg sm^{-3}. Further, we find that sulfate controls isoprene-OA formation in the power plant plume by enhancing both particle surface area and particle acidity, which enhances IEPOX uptake to particles and subsequent aqueous-phase reactions, respectively. Finally, we use these findings to explain the observed relationships between isoprene-OA, sulfate, particle acidity, and particle water in previous field studies.