Atmospheric fine aerosol (PM$_{2.5}$) adversely affects human health and air quality as well as plays a critical role in Earth’s climate. Organic aerosol (OA) contributes a substantial fraction to PM$_{2.5}$ mass. In order to investigate the formation, sources and behavior of OA in the Southeastern U.S., the Aerodyne Aerosol Chemical Speciation Monitor (ACSM) was deployed at a rural (Centreville, AL (CTR)) and an urban site (Jefferson Street (JST) in Atlanta, GA) for 1 year. The JST and CTR sites are part of the Southeastern Aerosol Research and Characterization (SEARCH) network. In addition to the continuous SEARCH measurements, high-volume filter samplers were periodically operated to collect PM$_{2.5}$, aiding in the identification of OA sources. At CTR, multilinear engine (ME-2) was applied to the yearlong OA mass spectral data in order to resolve OA sources. ME-2 resolved six factors: hydrocarbon-like organic aerosol (HOA), biomass burning organic aerosol (BBOA), low-volatility oxygenated organic aerosol (LV-OOA), semi-volatile oxygenated organic aerosol (SV-OOA), isoprene-epoxydiol organic aerosol (IEPOX-OA), and 91Fac. At JST, positive matrix factorization (PMF) and ME-2 were applied to yearlong and seasonal datasets to more clearly resolve certain OA sources and reasonably estimate mass contributions of each factor. The results indicate that the sum of LV-OOA and SV-OOA dominated the mass fraction of OA in all seasons (46-70%) at both sites. HOA was higher at JST than CTR. BBOA contributed a larger fraction of OA in colder seasons at both sites, particularly at JST where BBOA was related to residential burning. At both sites, IEPOX and 91Fac were highest in summer and were associated with the atmospheric chemistry of isoprene emissions. Thus, the last project was conducted in summer at another urban site of the SEARCH network, Birmingham, AL (BHM), during the 2013 Southern Oxidant Aerosol Study (SOAS) in order to investigate the impact of anthropogenic pollution on isoprene-derived secondary organic aerosol (SOA). The results reveal a moderate correlation ($r^2 = 0.57$) of methacrylic acid epoxide and hydroxymethyl-methyl-α-lactone-derived SOA tracers with nighttime nitrate radical production and strong correlation ($r^2 = 0.72$) with ozone during the daytime, confirming previous studies that anthropogenic pollutants enhance isoprene-derived SOA formation.

Committee:

Jason Surratt, Ph.D. (Advisor)
Manjula Canagaratna, Ph.D. (Aerodyne Research)
Avram Gold, Ph.D.
Richard Kamens (ESE, Retired)
Ken Sexton, Ph.D.