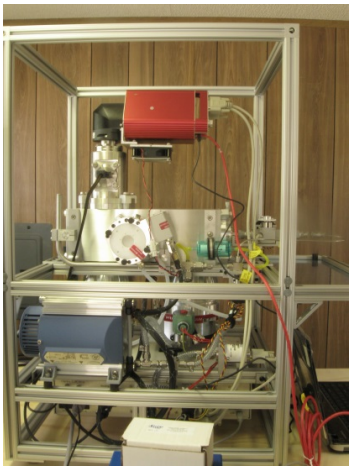

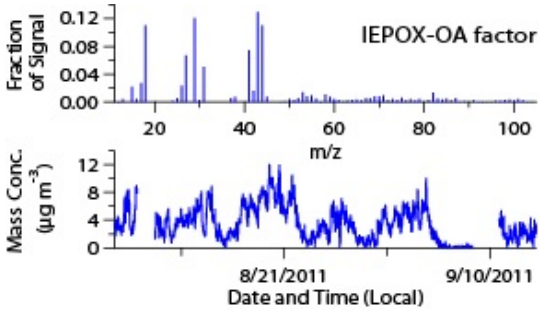

Tree and Human-Made Emissions Combine as Major Sources of Atmospheric Organic Aerosol in Southeastern U.S.

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0001 Michael Hooker Research Center
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Abstract

The chemical characteristics and sources of atmospheric organic aerosol (OA) in the southeastern United States are less understood than those in other geographic areas due to the complex mixture of human-made or anthropogenic (i.e., SO_2 from power plants, NO, and NO_2 from vehicles) and tree (i.e., abundant isoprene) emissions in this region. Previous studies in the southeastern U.S. were limited by low time resolution (i.e., hours or days) or low mass identification, and were subjected to sampling artifacts. Good chemical characterization of atmospheric OA requires real-time continuous measurements over different seasons to capture the variability of precursor emissions as well as changes in meteorological conditions. This seminar presents results from field studies conducted in Atlanta, GA, and Look Rock, TN in summer and fall 2011 and summer 2013, respectively. OA was found to contribute 69% of non-refractory particulate matter less than 1 μm in diameter in Atlanta. Real-time organic mass spectra were analyzed by positive matrix factorization (PMF), yielding three conventional factors (or sources): hydrocarbon-like OA (HOA), semi-volatile oxygenated organic aerosol (SV-OOA), and low-volatility OOA (LV-OOA). An additional OOA factor that contributed to 33% of the organic mass was resolved in summer only, corresponding to the high emissions of isoprene from trees. The analyses suggest isoprene-derived epoxydiols (IEPOX) as the source of this additional factor. At Look Rock, the organic aerosol fraction is about 64% and is all aged aerosol. Its PMF analysis suggests that 42% is likely IEPOX-OA factor and 57% is an OOA that has some correlation with isoprene and isoprene oxidation products (i.e., methyl vinyl ketone and methacrolein). No primary OA (e.g., HOA, cooking or biomass burning aerosol) was resolved from PMF analysis of the Look Rock dataset, which suggests negligible local emission sources. Observations of the IEPOX-OA factor in both downtown Atlanta and Look Rock (a high-altitude rural site) suggest that the southeastern U.S. air quality may be largely influenced by isoprene emissions as a regional source of organic aerosol. Some correlation of IEPOX-OA correlation with aerosol acidity ($r^2 = 0.3$), measured as H^+ (nmol m^{-3}), and sulfate mass loading ($r^2 = 0.48$) as found in Atlanta suggests that anthropogenic emissions likely enhance organic aerosol from tree emissions of isoprene.