

6.062 Measurements of organic composition of aerosol and rainwater samples using offline aerosol mass spectrometry.

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Abstract:

A thorough understanding of the sources, evolution, and budgets of atmospheric organic aerosol requires widespread measurements of the amount and chemical composition of atmospheric organic carbon in the condensed phase (within particles and water droplets). Collecting such datasets requires substantial spatial and temporal (long term) coverage, which can be challenging when relying on online measurements by state-of-the-art research-grade instrumentation (such as those used in atmospheric chemistry field studies). Instead, samples are routinely collected using relatively low-cost techniques, such as aerosol filters, for offline analysis of their chemical composition. However, measurements made by online and offline instruments can be fundamentally different, leading to disparities between data from field studies and those from more routine monitoring. To better connect these two approaches, and take advantage of the benefits of each, we have developed a method to introduce collected samples into online aerosol instruments using nebulization. Because nebulizers typically require tens to hundreds of milliliters of solution, limiting this technique to large samples, we developed a new, ultrasonic micro-nebulizer that requires only small volumes (tens of microliters) of sample for chemical analysis. The nebulized (resuspended) sample is then sent into a high-resolution Aerosol Mass Spectrometer (AMS), a widely-used instrument that provides key information on the chemical composition of aerosol particulate matter (elemental ratios, carbon oxidation state, etc.), measurements that are not typically made for collected atmospheric samples. Here, we compare AMS data collected using standard on-line techniques with our offline analysis, demonstrating the utility of this new technique to aerosol filter samples. We then apply this approach to organic aerosol filter samples collected in remote regions, as well as rainwater samples from across the US. This data provides information on the sample composition and changes in key chemical characteristics across locations and seasons.