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Chemically-Resolved Volatility Measurements of Organic Aerosol from Different Sources

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A newly modified fast temperature-stepping thermodenuder (TD) was coupled to a High Resolution Time-of-Flight Aerosol Mass Spectrometer (HR-ToF-AMS) for rapid quantification of chemically-resolved volatility of organic aerosols (OA) emitted from individual sources. The TD-AMS system was used to characterize primary OA (POA) from biomass burning, trash burning surrogates (paper and plastic), and meat cooking as well as chamber-generated secondary OA (SOA) from a-pinene and gasoline vapor. Almost all atmospheric models represent POA as non-volatile, with no allowance for evaporation upon heating or dilution, or condensation upon cooling. Our results indicate that all OAs observed show semi-volatile behavior and that most POAs are at least as volatile as SOA measured in urban environments. Biomass-burning OA (BBOA) exhibited a wide range of volatilities, but more often showed volatility similar to urban OA. Paper-burning resembles BBOA because of its high volatility and intermediate atomic oxygen-to-carbon (O/C) ratio, while meat-cooking OAs (MCOA) have consistently lower volatility than ambient OA. Chamber-generated SOA was significantly more volatile than urban SOA, challenging extrapolation of traditional laboratory volatility measurements to the atmosphere. Most OAs sampled show increasing O/C ratio and decreasing H/C (hydrogen-to-carbon) ratio with temperature, further indicating that more oxygenated OA components are less volatile.