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Preliminary Observations of organic gas-particle partitioning from biomass combustion smoke using an aerosol mass spectrometer

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Aerosols play important roles in adverse health effects, indirect and direct forcing of Earth's climate, and visibility degradation. Biomass burning emissions from wild and prescribed fires can make a significant contribution to ambient aerosol mass in many locations and seasons. In order to better understand the chemical properties of particles produced by combustion of wild land fuels, an experiment was conducted in 2009 at the U.S. Forest Service/United States Department of Agriculture (USFS/USDA) Fire Science Laboratory (FSL) located in Missoula, Montana, to measure volatility of open biomass burning emissions for a variety of fuel types. Both isothermal and temperature-dependent volatilization were studied, using an Aerodyne High-Resolution Time-of-Flight Aerosol Mass Spectrometer (HR-ToF-AMS) coupled with thermal denuder. Small quantities (200-800g) of various fuel types, primarily from the U.S., were burned in a large combustion chamber and diluted in two stages in continuous-flow residence chambers. The partitioning of particulate organic mass concentrations by the HR-ToF-AMS was evaluated for each fuel type using nominal dilution ratios characterized both by measuring flow rates in continuous-flow residence chambers and from the concentrations of several conserved tracers. The volatility of biomass burning smoke was found to vary across fuel types. Up to ~60% volatile loss of organic matter was observed as a result of dilution for some smoke samples (e.g., Lodgepole pine and Ponderosa pine). We will investigate relationships between volatility and several parameters such as the absolute mass concentration and chemical composition. We will also examine the behavior of biomass burning tracers, such as AMS m/z 60, under dilution conditions. Previous studies (e.g. Lee et al., AS&T 2010 and Aiken et al., ACP 2009) have observed a strong relationship between OA and AMS m/z 60 in fresh biomass burning smoke. We will examine whether this relationship is altered due to volatile losses of smoke particle constituents during dilution. Study findings have important implications for the use of improving air quality modeling and chemical markers to determine contributions of biomass burning events to ambient particle concentrations.

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