Combining smoke chamber biomass burning measurements with positive matrix factorization to improve identification of the sources of suspected and known ambient biomass burning plumes

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Black carbon-containing particles generated by the incomplete combustion of biomass effect air quality, impact human health and have a significant effect on the direct and indirect radiative forcing of regional and global climate. The FLAME 3 campaign occurred during September 2009 at the Fire Science Laboratory in Missoula MT examining the burning of a variety of biomass fuels.

The Aerodyne soot particle aerosol mass spectrometer (SPAMS) instrument provides online chemically speciated mass and sizing measurements of refractory particles and their coatings between roughly 50 and 600 nm in aerodynamic diameter. The chemical signature of black carbon during these burns showed considerable variation including changes in the percentage of fullerenic black carbon relative to total black carbon. Mass spectrums for two different smoke chamber biomass species burns are depicted in figure 1. Organic coatings and combustion efficiency also showed considerable variation with source fuel.

Positive matrix factorization (PMF) has been applied to the dataset examining all burns together (figure 2) providing more information on different mass spectral signatures and what types of source fuels as well as burn conditions contribute to these mass spectral signatures. The mass spectral signature of ambient plumes of wildfire burning, cookstove burning and PMF of these measurements are then compared with the FLAME 3 measurements and PMF. The variability of particle size, organic coating and combustion efficiency of the burn are also examined in the context of comparison with mass spectral signatures of the measurements and subsequent PMF analysis.

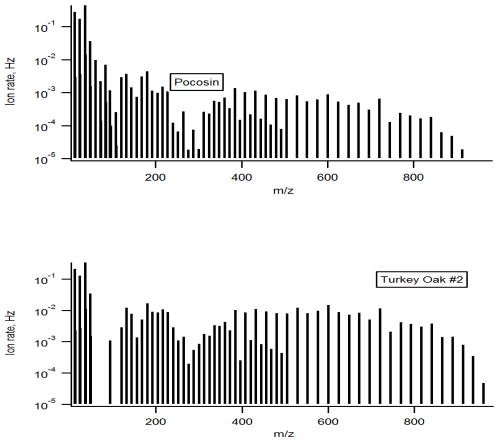

Figure 1; The mass spectrum of black carbon during a pocosin and turkey oak burn respectively.

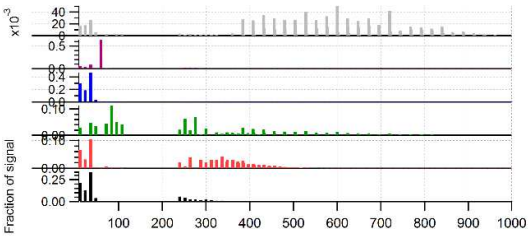

Figure 2; PMF of the black carbon signal for all burns combined depicted across mass spectrum. Six factors are present indicating variability.

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