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Aircraft Based Measurement of Organic Aerosol: Characterization and Evolution During the MILAGRO 2006 Field Campaign

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A high-resolution time-of-flight aerosol mass spectrometer (HR-ToF-AMS) was deployed for the first time on an airborne platform during the MILAGRO campaign in 2006. Measurements of size-resolved non-refractory PM1 aerosol components were made onboard the NCAR C-130. Organic aerosol (OA) accounted for over half of the aerosol mass and showed strong correlation with gas phase measurements of CO and HCN. Due to the correlations with HCN and CO, sources of OA are thought to be a combination of biomass burning (BB), transportation and other urban combustion sources, and (pollution-related) secondary OA. High mass resolution data also allowed for the calculation of the atomic oxygen to carbon (O/C) ratios of OA. This ratio has the lowest values in the city basin and increased values away from the city.

High-resolution OA mass spectra were also analyzed with a Positive Matrix Factorization algorithm, from flights with high and low BB contributions. Four OA components were extracted. Three oxidized components: OOA-I, OOA-II and biomass burning OA (BBOA) were obtained, and a reduced “hydrocarbon-like” (HOA) component. OOA-I is linked to regional air masses and highly oxidized. OOA-II appears to be a fresh SOA correlated with ammonium nitrate, and the city basin. During low fire periods it is the largest OA component in the city basin. BBOA is identified as biomass burning aerosol from a strong correlation with gas phase HCN, and AMS marker ions. During high burning periods, BBOA makes a large contribution to OA mass in the basin and the outflow. The evolution of the PMF factors as air is transported out of Mexico City shows an increase in OA mass after accounting for dilution, indicative of secondary OA formation in the plume. An increase in the contribution of OOA-I to the total mass is observed during transport from the city.