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Radiocarbon and Organic Tracer-based Source Apportionment Study of Carbonaceous Aerosol Collected during Two Ozone Regimes in Houston, TX, USA

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Houston is a prime study site for both primary and secondary carbonaceous organic aerosols due to the city's high anthropogenic activity combined with high potential for biogenic contributions from large forested regions that are proximate to the city. During NASA's DISCOVER-AQ sampling campaign in Houston, TX in September 2013, fine particulate matter ($PM_{2.5}$) samples were collected and measured for fraction contemporary and fossil carbon utilizing radiocarbon analysis. Contemporary sources can include primary and secondary aerosol from biomass burning, biogenic sources, meat cooking, etc. Fossil sources of carbonaceous aerosol include fossil fuel combustion, non-combustion sources and secondary aerosol from fossil precursors. Fraction contemporary carbon of samples collected from September 8 to 15 ranged from 45-67% with an average of 55% while samples from September 21 to 28 ranged from 47-70% with an average of 61%, both sample sets varying significantly. There were two different air quality regimes during the September campaign: multi-day increases in organic carbon (OC) with low ozone, and multi-day increases in OC with high ozone. To differentiate emission source, meteorology and photochemistry factors in these air quality regimes, HYSPLIT back trajectory, ozone, OC, radiocarbon and organic tracer-based chemical mass balance modeling were used. During the last week of the campaign (September 21-28) high ozone concentration and peak carbonaceous aerosol concentrations were observed throughout the Houston metropolitan area. HYSPLIT back trajectory (BT) analysis also indicates a shift in air mass contributions which corresponded to changes in radiocarbon, ozone and OC concentrations. Daytime OC concentrations for the two different regimes are correlated with ozone daily max at a downtown Houston site (r^2 = 0.57). Daytime fossil carbon concentrations have a higher correlation with ozone than contemporary carbon concentrations (r^2 = 0.51 and 0.32, respectively). However, contemporary carbon has a higher correlation to OC than does fossil carbon (r^2 = 0.90 and 0.81, respectively).