Variability in source impacts for residential indoor and outdoor PM2.5 in NEXUS homes

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A primary goal of NEXUS is to investigate associations between exposure to traffic-related air pollution and the respiratory health of asthmatic children living near major roadways in Detroit, MI. Understanding the contribution of traffic sources to exposure and how that varies between participants is critical to the study. Traffic-related source impacts were examined using daily PM2.5 species measured indoors and outdoors at 25 participant homes, outdoors at two area schools, and within 100m of a major highway (I-96). PM2.5 sample filters were analyzed for black carbon (BC) using transmittance and for water soluble and acid-extractable trace elements using High-Resolution Inductively Coupled Plasma-Mass Spectrometry (HRICP-MS). Residential air exchange rates were measured concurrently.

PM2.5 species related to traffic sources (e.g. Ba, Cu) were highest at the I-96 site whereas BC, Zn and Pb were elevated at a school located near an international border crossing with heavy diesel traffic and downwind of an industrial area. PM2.5 species measured outdoors at participants' homes near major roadways also had elevated levels of Ba and Cu. Ba and Zn were highly water-soluble across all sites and indoor levels were ~80% of outdoors. However, only 50% of the Cu and Pb in outdoor samples were water-soluble.

The Positive Matrix Factorization for Exposure (EPA PMF_{ex}) receptor model was applied to the data to identify combinations of PM2.5 species that represent different sources contributing to measured levels both outdoors and indoors, and to quantify their relative impacts. Traffic sources included combustion-related emissions and brake and tire wear. The contribution of traffic-related and industrial sources varied, while regional sulfate and crustal contributions were more consistent across sites. Infiltration of traffic-related PM2.5 sources indoors ranged from 40-60%, increasing with air exchange rates, and was lower than regional sulfate but higher than crustal.