Project Summary

The objectives of this project are to (1) design and build a platform to measure the size, morphology, and elemental composition of sub-10 nm particle emissions and (2) to demonstrate that the platform can be used for source identification and apportionment studies and creation of the detailed maps with emission inventories for sub-10 nm particles in urban environments. The mobile platform will deploy a battery of three condensation particle counters with size cuts of 2.5, 5, and 10 nm. These will provide a high time resolution particle number concentration in the size bands 2.5-5 nm, 2.5-10 nm, and 5-10 nm while the vehicle is moving. This setup will provide information about the spatial distribution of sub-10 nm particle number concentration. A nano differential mobility analyzer will be used to measure the particle distribution between 5 and 50 nm and to collect sub-10 nm particles onto substrates for laboratory analysis by transmission electron microscopy while the vehicle is stationary. Electron microscopy will provide information about particle morphology and elemental composition from energy dispersive spectra. Geospatial statistics will be used to interpolate between measurements and to create multiple city-scale maps of sub-10 nm particle concentration and chemical composition. Gaussian plume analysis will be used to estimate the source location and emission rate of selected observed plumes. The project outputs include (1) a mobile sampling system with real-time mapping, (2) city-scale sub-10 nm concentration maps for two urban centers in the South Eastern U.S., (3) a source inventory describing emissions from selected sources, and (4) a target inventory that will highlight geographical areas with likely high-toxicity sources, exceptionally strong sources evidenced by large emission rates or high number concentrations, and plumes affecting residential neighborhoods, schools, hospitals, and other community locales with potential for high impacts on human health or community well-being. The main outcome of the proposed work is a new validated technique using a mobile near-source measurement system that quantifies the emission rates of fugitive sub-10 nm particle emissions.