# Size-resolved Eddy-Covariance Particle Flux Measurement during the TRACER Campaign

*Background.* The overall goal of the Tracking Aerosol Convection Interactions ExpeRiment (TRACER) campaign is to provide high temporal and spatial resolution observations of convective clouds in the Houston region, over a broad range of environmental and aerosol regimes. This proposal is in response to the call for studies that build upon the measurements that the Atmospheric Radiation Measurement Climate Research Facility will make for aerosol and cloud processes, with a focus on aerosol processes relevant to the formation and growth of atmospheric new particles, the influence of aerosol composition, mixing state, and physical properties on aerosol growth, aging, and removal processes, and aerosol-cloud interactions. This project will deploy a unique instrument package during the intensive observation period of the campaign. The package includes aerosol instrumentation for size-resolved eddy-covariance particle flux measurement, refractory black carbon measurements, and a hygroscopicity tandem differential mobility analyzer.

*Motivation.* One stated science objective of the campaign is to "advance fundamental process-level understanding of updraft kinematics and microphysics (including aerosol ... signatures)". To achieve this objective, aerosol observations at ground level must be connected with aerosol conditions aloft. This means identifying time periods when surface observations realistically represent the aerosol ingested into clouds. Sizable vertical turbulent particle fluxes will be one indication that the boundary layer is not well mixed. Furthermore, previous studies have shown that new particle formation may be initiated aloft under conditions that are decoupled from the surface. The possibility of new particle formation aloft complicates the interpretation of aerosol data collected during a surface-based campaign such as TRACER.

*Objectives.* The overall objectives of the project are (1) Quantify turbulent vertical particle fluxes during the intensive observation period in Houston, Texas; (2) Quantify the hygroscopic growth factors and hygroscopicity parameter of the compounds that are responsible for modal aerosol growth during new particle formation/growth events; (3) Quantify turbulent aerosol mass flux derived from the co-located remote sensors; and (4) Create quality-controlled data products that support science following from the data collected during the campaign.

*Methods.* The instrument payload will be deployed collocated with a suite of *in-situ* and remote sensing aerosol instruments at the urban site near the LaPorte airport to take advantage of the full range of available aerosol measurements. Vertical fluxes of total and size-selected particles will be measured using the the eddy covariance technique. For the eddy covariance measurements, we will dedicate 3 condensation particle counters, a single particle soot photometer, and a portable optical particle spectrometer. Three condensation particle counters with different diameter ($D$) cuts ( $D > 2.5$ nm, $D > 10$ nm, and $D > 40$ nm), the single particle soot photometer ($70 < D < 500$ nm measuring refractory black carbon), and the optical particle spectrometer (180 nm < $D$ < 3000 nm) will be sheltered inside a climate-controlled enclosure at the top of a 10 m tower used for flux measurements. The instruments will be operated to infer size and composition-dependent number and mass fluxes.

*Outcomes.* The flux measurements will provide critical information about the vertical distribution of various aerosol size classes. The remote sensors will provide time-height profiles of approximate particle mass fluxes. The single-particle soot photometer will provide direct measurements of refractory black carbon mixing state, which provides important information about the influence of refractory black carbon particles on the microphysical properties water and ice clouds. The data will be processed into in a series of archived data products that will be directly usable to support future science objectives.