Application of High-Resolution Large Eddy Simulations Toward an Improved Understanding of Aerosol Flux Measurements

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Background. Eddy-covariance aerosol flux measurements are an important tool for quantifying bidirectional surface-atmosphere exchange rates. They can address important science questions related to aerosol processes that are critical for understanding aerosol-cloud climate interactions, including (1) vertical localization of new particle formation, (2) identification and quantification of surface emissions, and (3) assessment of particle dry deposition velocity.

Motivation. True aerosol exchange rates are difficult to verify due to a lack of viable alternate methods against which aerosol eddy-covariance measurements can be compared. The lack of viable alternative methods and the lack of external constraints are the fundamental reasons why – despite decades of research – the magnitude of submicron aerosol emissions and dry deposition remain unsolved open questions. This in turn, significantly contributes to the uncertainty of aerosol treatments in regional/global air quality and climate models. To better quantify surface-atmosphere exchange rates of aerosol, this proposal seeks to evaluate and optimize aerosol flux measurement methodology using a simulation testbed framework.

Objectives. The overall objectives of the project are to (1) carry out high-resolution large eddy simulation studies to relate simulated turbulent aerosol flux measurements to prescribed aerosol surface exchange rates, (2) to evaluate the magnitude and uncertainty of various turbulent aerosol flux measurements made with DOE ASR/ARM support, and (3) to evaluate the full range of currently used aerosol flux measurement methodologies and propose best practices for future measurement campaigns.