Synthesis of Aerosol Physical, Chemical, and Radiative Properties from Various Sources: Consistency and Closure

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Aerosol direct radiative forcing is determined from a set of optical properties -- aerosol optical depth, single scattering albedo, and asymmetry parameter -- which can be obtained from a range of different measurement techniques. Every technique has unique limitations, thus uncertainty and bias in radiative forcing estimates can vary widely depending on the measurement approach used. Given that a small fraction of these observations are most widely used for climate change studies, a comprehensive assessment of the interrelationship among all measurements would be of benefit. We present a synthesis of Atmospheric Radiation Measurement (ARM) aerosol products from ground-based *in situ* and remote sensing techniques together with the NASA Aerosol Robotic Network (AERONET) and satellite observations with the goal of testing these products for consistency. Physical (size distribution) and chemical composition data are used to derive aerosol optical properties and the results are compared to observations from the nephelometer and particle/soot absorption photometer instruments as well as derived products from the ground-based radiometers. Dependence on humidity related particle growth is included in the analysis. We furthermore present results from a closure study in which the above properties are used to derive surface broadband shortwave radiative fluxes from a model and compared to the analogous measurements. To obtain the latter we reconstruct vertical profiles of aerosol properties by combining ground-based *in situ* aerosol measurements with remotely sensed vertical information of atmospheric properties. The primary objective of this work is to provide greater confidence in the characterization of aerosol optical properties in different regimes in order to better constrain observationally-based and modeled aerosol radiative forcing estimates. Understanding how aerosol optical properties and radiative forcing vary, and covary, in different regions of the globe can improve assumptions required for retrievals and products from satellite-based observations. Understanding how these radiative quantities covary with chemical composition can help to relate that information to processes parameterized in models that address the climate impact of aerosols.

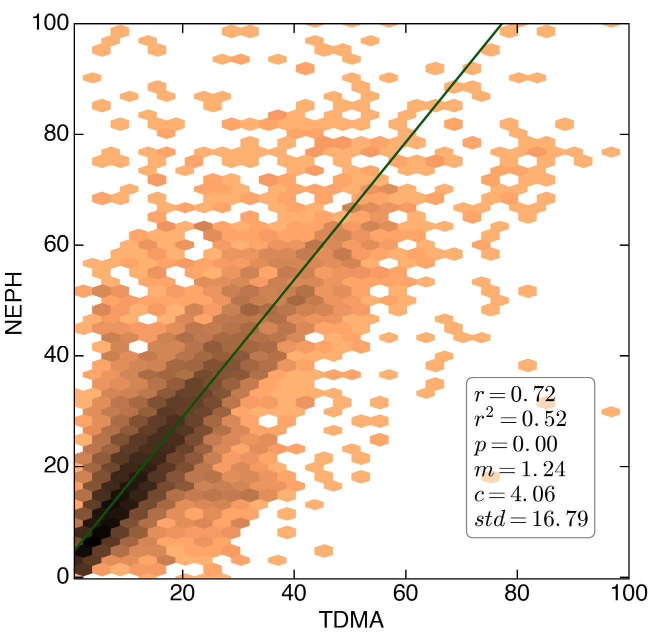

Figure 1. Correlation between aerosol scattering coefficients as measured and derived from particle size distributions at the ARM's Southern Great Plains site.