Finding a Method to Measure the Black Carbon State of Mixture in Atmospheric Aerosol

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Black carbon (BC), the predominant source of solar absorption in atmospheric aerosol, can be present in three states of mixture: (1) an external mixture where BC particles are distinct from scattering particles, (2) a homogeneous internal mixture where BC is mixed with scattering components throughout the particle, and (3) a coated internal mixture where BC particles are coated with a scattering component. Radiative forcing for these different states of mixture may range from negative (cooling) for external mixtures to positive (warming) for coated internal mixtures with a magnitude equal to that for the greenhouse gas methane. Currently, there is no method to measure the BC state of mixture and assumptions in climate models may lead to large errors in aerosol radiative forcing. Here we investigate a method to measure the BC state of mixture using a multi-instrument approach and an associated inversion algorithm to extract information from the measurements. Measurements will be made while following an air parcel to study the temporal evolution of the BC state of mixture. The multi-instrument approach eliminates ambiguities that arise from measurements relying on a single instrument. In conjunction with the measurements from several instruments, the inversion will provide not only the BC state of mixture but also uncertainties in the determination, improving the accuracy of retrieved data.

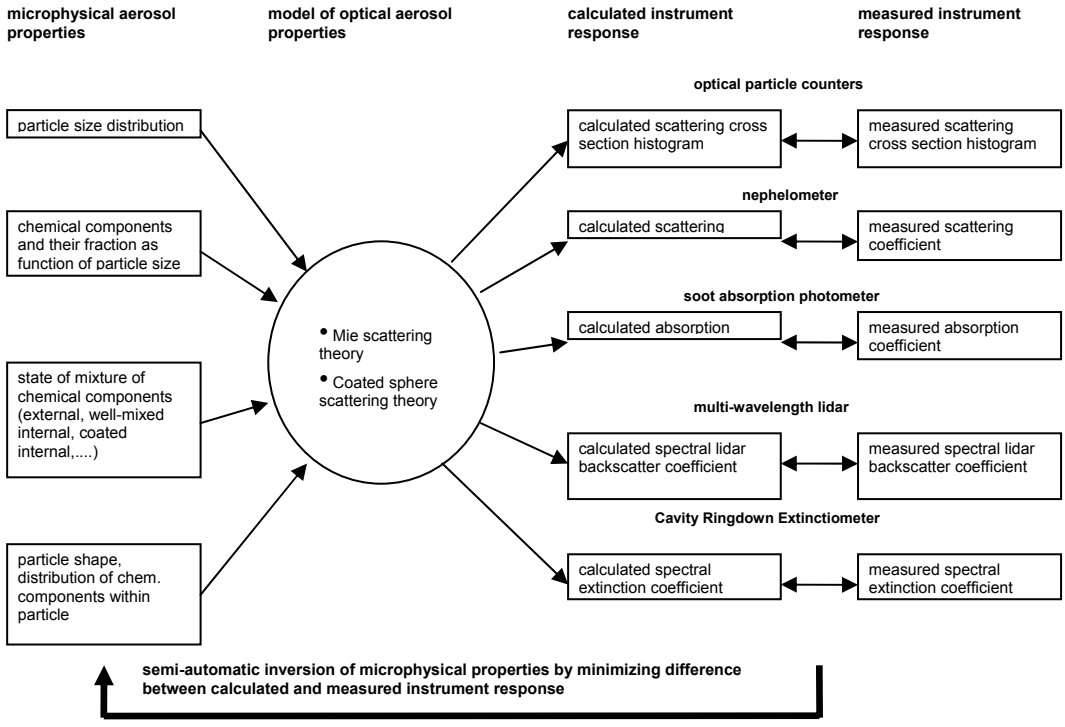

Figure 1. Diagram illustrating the multi-instrument approach for measuring the state of mixture of particulate black carbon. A description of the aerosol's microphysical properties is used as input for a model calculating aerosol optical properties and instrument responses. The responses are studied while varying the microphysical properties to find an instrument combination resolving the black carbon state of mixture.