

Measuring Soot Optical Properties Using Cavity Attenuated Phase Shift (CAPS) Techniques

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We describe a robust, field deployable monitor which employs cavity attenuated phase shift techniques to simultaneously measure both ambient particle optical extinction and scattering (and thus single scattering albedo, SSA) on the same sample volume with high precision and accuracy. In order to measure the scattering, a Lambertian integrating sphere is incorporated within the optical cavity. The scattering measurement is calibrated using small salt particles and using the extinction channel as an absolute standard. Typical precision levels in both channels are less than 1 Mm^{-1} ($1s$, 1σ). With an appropriate change in mirrors and LED, measurements can be made at wavelengths ranging from 450 to 780 nm. This range is limited at long wavelengths by the availability of suitable detectors and at short wavelengths by the availability of suitable mirrors. We will present results of optical measurements of flame-produced soot, both in nascent form and with organic and inorganic coatings. The aim of this study is to understand the influence of such coatings on the absorption properties of ambient "black carbon" as compared to primary soot emissions. At low SSA, determination of absorption using the subtraction technique (extinction - scattering) offers a viable alternative to traditional methodology employing photoacoustic or filter-based techniques for the measurement of primary emission sources such as diesel, gasoline and aircraft engines.

