Geophysical Research Abstracts
Vol. 18, EGU2016-9236, 2016
EGU General Assembly 2016

Measurements of Soot Mass Absorption Coefficients from 300 to 660 nm

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Soot, a product of incomplete combustion, plays an important role in the earth's climate system through the absorption and scattering of solar radiation. In particular, the assumed mass absorption coefficient (MAC) of soot and its variation with wavelength presents a significant uncertainty in the calculation of radiative forcing in global climate change models. As part of the fourth Boston College/Aerodyne soot properties measurement campaign, we have measured the mass absorption coefficient of soot produced by an inverted methane diffusion flame over a spectral range of 300-660 nm using a variety of optical absorption techniques. Extinction and absorption were measured using a dual cavity ringdown photoacoustic spectrometer (CRD-PAS, UC Davis) at 405 nm and 532 nm. Scattering and extinction were measured using a CAPS PMssa single scattering albedo monitor (Aerodyne) at 630 nm; the absorption coefficient was determined by subtraction. In addition, the absorption coefficients in 8 wavelength bands from 300 to 660 nm were measured using a new broadband photoacoustic absorption monitor (UGA). Soot particle mass was quantified using a centrifugal particle mass analyzer (CPMA, Cambustion), mobility size with a scanning mobility particle sizer (SMPS, TSI) and soot concentration with a CPC (Brechtel). The contribution of doubly charged particles to the sample mass was determined using a Single Particle Soot Photometer (DMT). Over a mass range of 1-8 fg, corresponding to differential mobility diameters of $\sim$150 nm to 550 nm, the value of the soot MAC proved to be independent of mass for all wavelengths. The wavelength dependence of the MAC was best fit to a power law with an Absorption Ångstrom Coefficient slightly greater than 1.