6.185 New method for the calibration of an Aerosol Photo-Acoustic Spectrometer for in-situ measurement of Black and Brown Carbon.

Early Career Scientist

Presenting Author:
Katie Foster, Department of Atmospheric Science, University of Wyoming, Laramie, Wyoming, USA, ktafoster@gmail.com

Co-Authors:
Rudra Pokhrel, Department of Atmospheric Science, University of Wyoming, Laramie, Wyoming, USA
Matthew Burkhart, Department of Atmospheric Science, University of Wyoming, Laramie, Wyoming, USA
Shane Murphy, Department of Atmospheric Science, University of Wyoming, Laramie, Wyoming, USA

Abstract:

Black carbon (BC) is estimated to have a strongly positive radiative effect on climate that is second only to CO_2 and methane. However, there are large uncertainties in the measurement of BC absorption, and the even greater uncertainty in quantifying the effect of organic coatings enhancing BC absorption and absorption from the organic coatings themselves (known as Brown Carbon). Moreover, while it is known that biomass burning (BB) accounts for a large fraction of black and brown carbon emissions, field studies directly measuring BB absorption are limited. The University of Wyoming has constructed an Aerosol Photo-Acoustic Spectrometer (PAS) based on the instrument developed by Lack et al. (2006) for the quantification of absorption in pertinent aerosols. This instrument has been deployed in a mobile laboratory to measure absorption properties of aerosols emitted during wildfires. The PAS has two cells at 405 nm and two cells at 660 nm wavelength which, coupled with a thermodenuder, measure absorption enhancement from organic coatings and brown carbon. The existing method for calibration of a multi-pass PAS is to use ozone. However, the absorption cross section of ozone at 405 nm is small enough to render direct calibration of this channel difficult without extremely large ozone concentrations. Here we present a new technique for calibration of the PAS, utilizing an Aerodyne Cavity Attenuated Phase Shift – Single Scattering Albedo (CAPS-SSA) instrument at both 660 and 405 nm. Absorbing aerosols (Aquadag, fullerene soot, or died polystyrene latex) are size-selected using a Differential Mobility Analyzer (DMA) and passed through both the CAPS-SSA and PAS in series. From the CAPS-SSA measurement, both extinction and scattering will be quantified, and when subtracted, an absorption value. From this we reliably correlate our PAS acoustic response to absorption (Mm^{-1}) at each wavelength.