

***EVOLUTION OF BLACK CARBON MIXING-STATE IN AN
URBAN-BIOGENIC ENVIRONMENT***

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ABSTRACT

As part of the Carbonaceous Aerosol and Radiative Effects Study (CARES), the Department of Energy Gulfstream-1 (DOE G-1) aircraft was deployed to investigate the time evolution of aerosols in a mixed urban-biogenic environment through measurement flights conducted in the morning and afternoon. Relevant to the present presentation, the G-1 payload included a 3- λ PSAP, a 3- λ nephelometer, CPCs, a Single Particle Soot Photometer (SP2), an Aerodyne Mass Spectrometer (AMS), and gas phase tracers for emission sources. The SP2 – which generates datasets on the BC mass/number concentration, BC mass equivalent diameter (MED), and degree of BC coating – can be combined with the AMS dataset to calculate the light absorbing properties of the Sacramento BC emissions that can be compared to field measurements.

The degree of black carbon (BC) coating can be estimated by comparing the time difference between the SP2 scattering signal peak (τ_{SC} ; $D_p = 175\text{-}400$ nm) and the incandescent signal peak from the BC core (τ_{BC} ; mass equivalent diameter = 60 - 650 nm). For nascent soot, defined as soot with a negligible coating, the time difference, $\Delta\tau$ ($= \tau_{BC} - \tau_{SC}$), will be nominally zero since both the light scattering and incandescence signal will be from the uncoated BC. In contrast, a thickly-coated BC particle will exhibit a non-zero $\Delta\tau$ because light scattering will initially be from coating material that must first "boil" off before the BC core can incandesce. It is this time – to vaporize the coating material off the BC core – that can be used to probe the mixing state of BC. For those conditions where thickly-coated BC is observed, data from the AMS can be used to probe the coating composition and, as described below, be used with the SP2 dataset to estimate light absorption enhancement brought about by the coating using the core-shell model.

A comparison between the morning and afternoon flights on June 28th will be presented where the SP2 lag-time data shows significant growth of coated soot in the afternoon. It will be shown that the coated soot distribution can be reconstructed using an estimate of the coating thickness for a given soot core diameter and a simplified condensation model that, in turn, can be used to predict light absorption amplification. Since the concomitant AMS dataset reveals that nominally 90% of the non-refractory material sampled in the afternoon flight is organic, the coating material used in this calculation is assumed to be organic in origin. Comparison of model prediction with light absorption enhancement tabulated using the PSAP (particle soot absorption photometer) and SP2 reveals that the field measurement is nominally 2x larger. It is suggested that this difference is attributed to an organic aerosol bias in the PSAP measurement as introduced by Lack et al. (2008).

Lack, D. A., et al., (2008) Bias in Filter-Based Aerosol Light Absorption Measurements Due to Organic Aerosol Loading: Evidence from Ambient Measurements, *Aerosol Sci. Tech.* **42** 1033- 1041.

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