

***EVOLUTION OF BLACK CARBON MIXING-STATE IN THE
SACRAMENTO URBAN-BIOGENIC ADMIXED ENVIRONMENT***

Arthur J. Sedlacek, III¹, Larry Kleinman¹, John E. Shilling², R. Subramanian³, Stephen R. Springston¹, Rahul Zaveri²

¹Atmospheric Sciences Div., Brookhaven National Laboratory;

²Atmospheric Sciences and Global Change Div., Pacific Northwest National Laboratory

³Droplet Measurement Technologies

For presentation at
The Second Science Team Meeting of the
Atmospheric System Research (ASR) Program,
San Antonio, TX
March 28-April 1, 2011

**Environmental Sciences Department/Atmospheric Sciences Division
Brookhaven National Laboratory**

**U.S. Department of Energy
Office of Science**

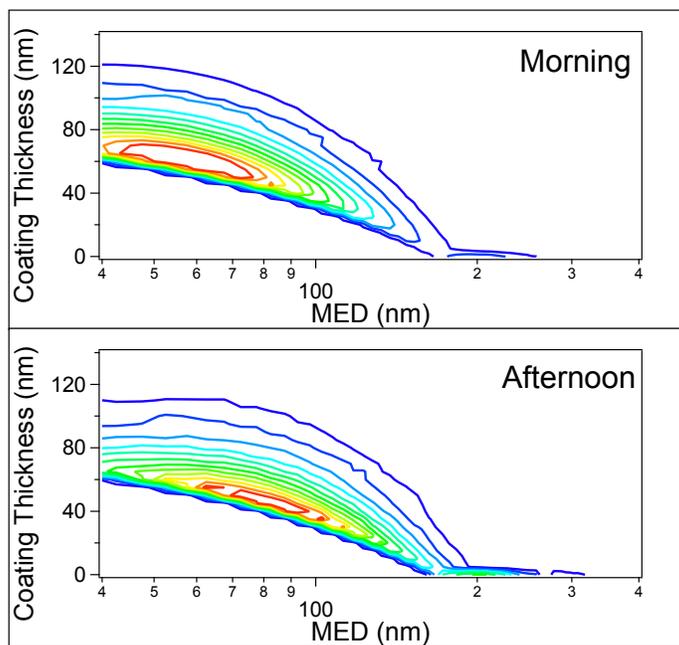
NOTICE: This manuscript has been authored by employees of Brookhaven Science Associates, LLC under Contract No. DE-AC02-98CH10886 with the U.S. Department of Energy. The publisher by accepting the manuscript for publication acknowledges that the United States Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce the published form of this manuscript, or allow others to do so, for United States Government purposes.

ABSTRACT

As part of the CARES campaign, the DOE G-1 was deployed to investigate the temporal evolution of aerosols in a mixed urban-biogenic environment through morning and afternoon flights. Of specific interest to the present poster is the evolution of the black carbon (BC) mixing state. As will be discussed, the incandescence and scattering channels available on the SP2 can be combined to allow details of the BC mixing state to be studied.

SP2 analysis of data collected on June 28th reveal that significant evolution in the BC mixing state took place, as evidenced by the growth of coated accumulation mode BC particles. In addition probing the BC mixing state, it is also shown that the coated soot distribution for the afternoon flight can be reconstructed via an estimate of the coating thickness for a given soot core diameter along with a simplified condensation model. Using the G-1 AMS observation that nominally 90% of the non-refractory material was organic and the reconstructed coated core distribution, the expected light absorption enhancement can be calculated and compared to that measured in the field. Comparison of this model with that tabulated using the PSAP (Mm^{-1}) and SP2 (ng/m^3) 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 (Lack et al., 2008).

In addition to the airborne comparisons, comparisons were also carried out between the G-1 and ground sites. On June 15th, SP2 calculated mass mean diameters (MMD) for the T0 (Sacramento) and T1 (Cool) ground sites were found to be 143 nm and 175 nm respectively. It is also reported that mixing-state analysis suggests that while both sites were dominated by thinly-coated BC, there are likely more thickly-coated, sub-100 nm MED BC cores at T1. [ASR poster: Subramanian et al., 2011] This mixing-state observation is consistent with that observed aboard the G-1 where analysis of the mixing layer suggests that BC is dominated by fresh emissions while the residual layer is comprised of an admixture of nascent and thickly-coated soot aggregates, similar to that observed over the foothills (T1 site location). However, comparison of the G-1/ground MMDs are mixed. Whereas the G-1 mixing layer MMD of 147 nm is in excellent agreement with the reported for the T0 site (143 nm), the T1 MMD (175 nm) is nominally 15% higher than the measured 150 nm aboard G-1 while over the foothills area.



Comparison of the incandescence-based mass equivalent diameter for BC particles to the light scattering-based estimates optical diameter enables the SP2 to probe the mixing state of BC. In the plot above, it can be seen that while coated 115 nm BC particles were negligible in the AM, by the afternoon flight these particles gained a coating to yield optical diameter $D_p \sim 225$ nm. Put another way, between the morning and afternoon flights conducted on June 28th, 115 nm diameter BC particles become encapsulated within a shell that is nominally 55 nm thick.