Deliverable D15: Observational Framework to Constrain Carbonaceous Aerosols in Mixing-State in Model

Objective: Evaluate "aging" treatments of mixing-state/phase of carbonaceous (Black-Brown-Clear) aerosols on "absorption" and "lifetime" in models using ASR lab (FLAME, BC) & Field (LANL-Fire, CARES, Detling, Pico, BBOP) observations.

Lead personnel: Dubey, Mazzoleni, Cappa, Aiken, Donahue, Zaveri, Fast, Feng

Collaborators: Ghan, Williams, Onasch, Rasch, Horowitz, Donner - Open

Funding status: Proposed

Challenges resources/collaborators: Cross-cutting interactions between laboratory, field and modeling investigators in ASR and ESM (Dorothy Koch). Combine mixing state, Mie, Kohler-modules (AMT, ESM) & field input parameters (SEM, SP-AMS, PASS, PTI, Aeth….)

Summary of progress:

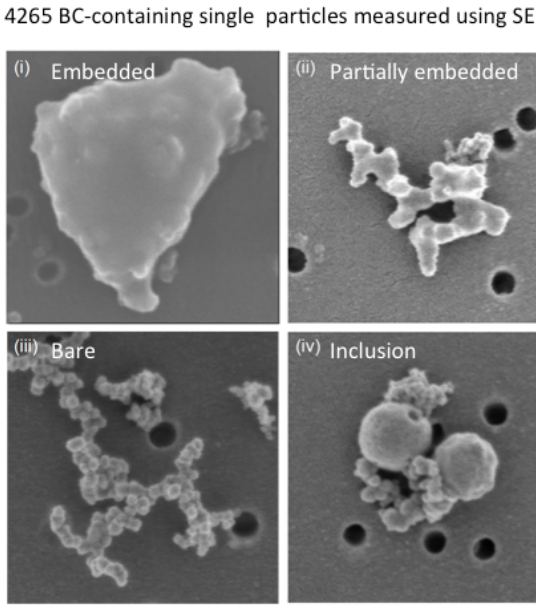
(1) SEM and PASS-3 analysis of BC at Detling shows that absorption enhacement scales with coating thickness (Liu in prep, China NatureC 13)

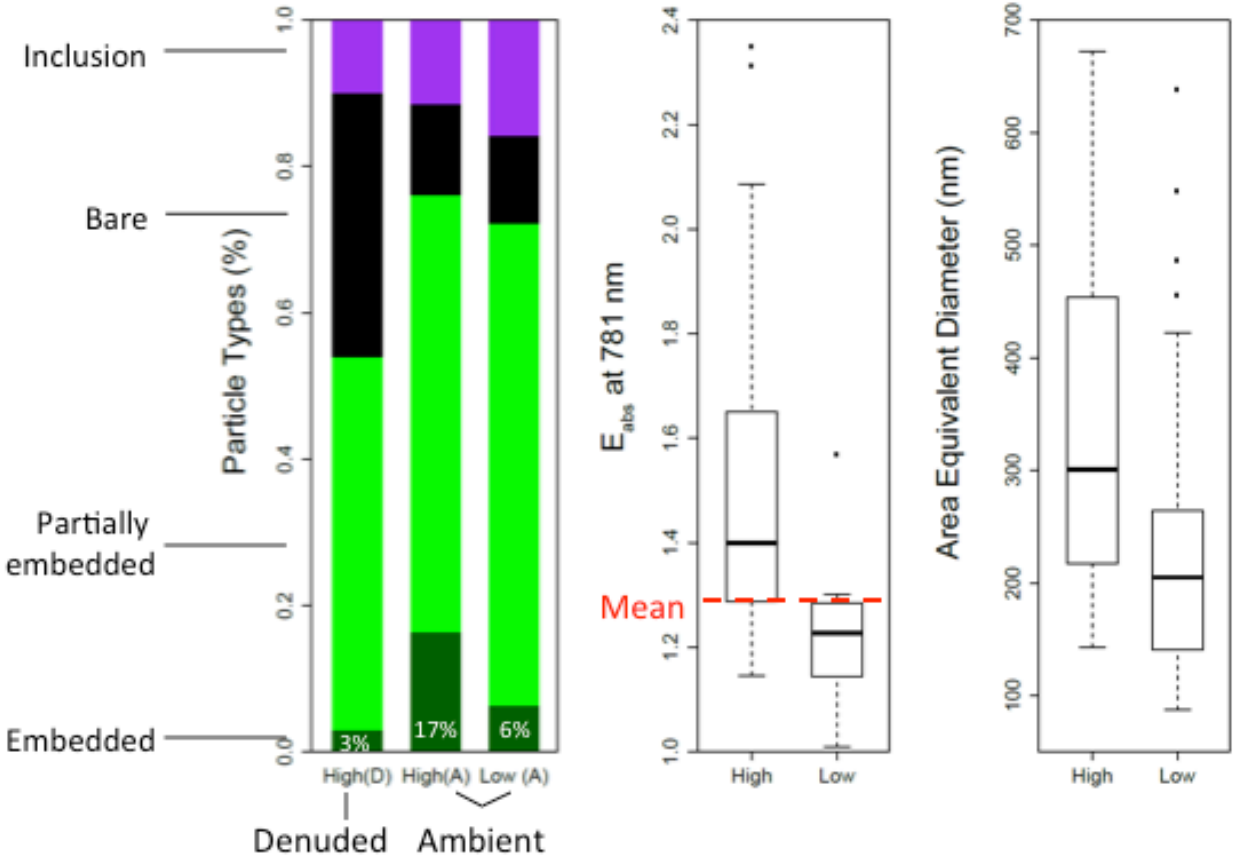
(2) Soot inclusion fraction versus age in fires relatively constant at < 20 hrs important for absorption and lifetime (Aiken in prep, Huang ACP 13

(3) Detling & Flame4 data detect low volatility Brown Carbon correlated with Black Carbon that needs to be included in mixing models (Liu in prep & Saleh in prep)

Enhancement vs Mixing State at Detling (SEM, PASS-3, denuder)

Reducing coated BC fraction by 14% increased E_{abs} by 20%





- High E_{abs} samples have more embedded type particles.
- High E_{abs} samples have larger particles.

Mixing state as a function of aging effects absorption (lensing) and lifetime (hydrophobic/hydrophylic) and is uncertain in models

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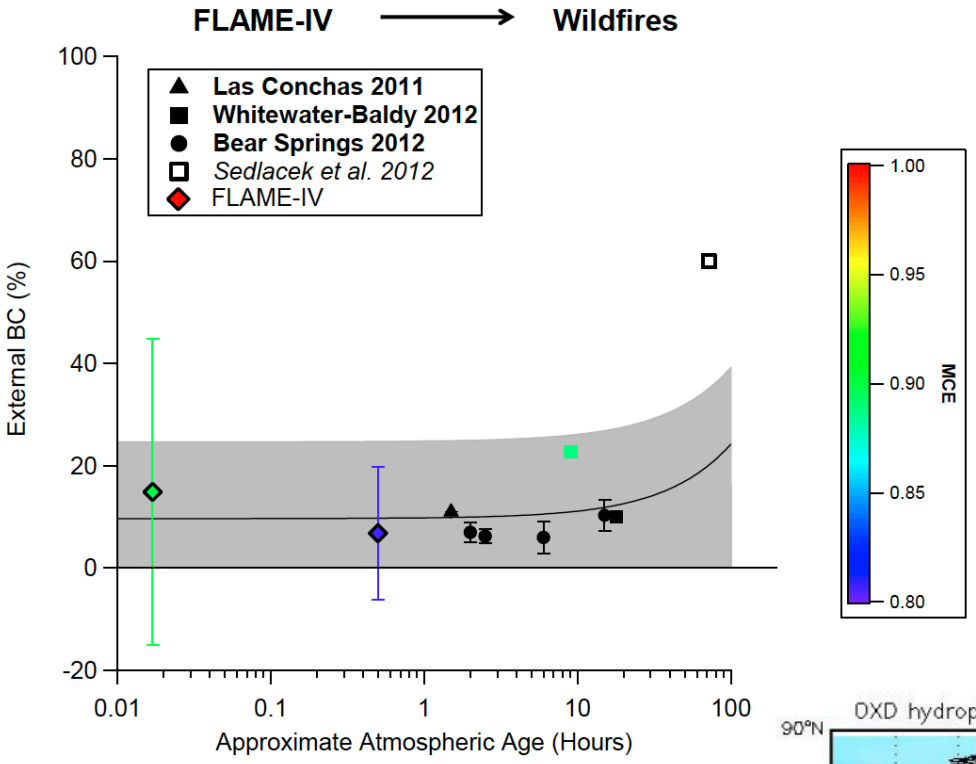

SP2 –ve Lag time
Aiken in prep

MCE dependence
Liu GRL 13 in rev.

GEOS-CHEM BC Aging by O_3/H_2O
Huang ACP 13

$$\tau_{OXD} = \frac{1}{k_{OXD}} = \frac{1 + K_{O_3}[O_3] + K_{H_2O}[H_2O]}{K_\infty K_{O_3}[O_3]}$$