Time Evolution of Aerosol Light Scattering Observed in Wildland Fires in BBOP


About changes in Mass Scattering Efficiency, Aerosol Size Distribution, and Tar Balls that occur in a fire plume within a few hours.

Wildland fires sampled in Pacific NW during BBOP

Flights included one or two sets of transects. Each set contained up to 6 plume crossings

Time evolution determined by comparing measurements near the fire source to those 2 to 4 hours downwind.

CO is used as a conservative tracer to account for dilution

We are focused on processes that:
- operate on a ½ to 4 h time span and
- have radiative impacts due to aerosol scattering and absorption

Common Features

**Ratio Org/CO does not change much, ~ 25%**

**Ratio Scattering/CO can double**

Table gives percent change in Org/CO, Scat (550nm) /CO, and Scat./Org over ~ 2 hours.

Last column gives values of MSE over fire and downwind

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<tbody>
<tr>
<td>726a</td>
<td>+18%</td>
<td>+28%</td>
<td>+7%</td>
<td>5.8 – 6.2</td>
</tr>
<tr>
<td>730b</td>
<td>+25%</td>
<td>+81%</td>
<td>+41%</td>
<td>3.4 – 4.8</td>
</tr>
<tr>
<td>821b</td>
<td>+27%</td>
<td>+101%</td>
<td>+48%</td>
<td>3.4 – 5.0</td>
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**Notes:**

Mass scattering efficiency (MSE) is scattering per unit mass. MSE depends on particle size and refractive index
BB values reported in the literature are centered on ~ 3.5

Org (~ equal total aerosol mass) has not been corrected for the SP-AMS collection efficiency (CE). If CE=0.5, then the MSEs above are doubled, yielding likely unrealistic values

Can the increase in MSE be explained?

- Change in aerosol size distribution?
- Change in SP-AMS detection?

**Mie Calculations** – an example set of Log Normals

Large value for MSE difficult to explain

**Colockum Tarps fire 730b with tar ball analysis**

**Tar Balls**

Kouji Adachi, Peter Buseck, TEM

Fraction of particles that are Tar Balls increase with Age

Tar Balls are refractory, surviving slow heating to 600C

AMS vaporizes aerosol at 600C.

**Tar Ball mass fraction ~ 25% at 2.5 hours**

AMS might be missing 25% of Org mass

**MSE change decreases if aged Org is 25% > measured**

**Path Forward**

- More case studies of Tar Balls
- Detection efficiency of TB by AMS in lab
- Lab expts on UHSAS response to coincidence
- Constrain size distribution using all particle and scattering data