Measurements of Black Carbon Particles and their Coatings by SP-AMS during the Clearflo campaign

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Soot Particle Aerosol Mass Spectrometer (SP-AMS)

Combines the DMT Single Particle Soot Photometer, SP2 and the ARI High Res. Time-of-Flight AMS

- Composition of the refractory component of submicron aerosol
- Laser incandescence + EI ionization + mass spectroscopy
- Only refractory particles are vaporized in laser (soot core + coating)
- Conventional vaporizer may be left in or removed

Onasch et al., 2011, submitted to AS&T
SPAMS Measurements at Detling Site

- Conducted measurements with and without the thermal denuder upstream
- Conducted measurements with and without the standard vaporizer installed
- I’m presenting data focusing on measurements using only the laser vaporizer and without the thermal denuder in this talk
- These measurements are of soot particles and their coatings only
We can focus on individual plumes with the goal of determining their source.
Plume 1

Fullerene 2.7% of total BC

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Coefficient values ± one standard deviation

\[ a = 0 \pm 0 \]
\[ b = 2.1679 \pm 0.048 \]
Plume 1

high coatings of organics, high fullerenes

No wind

Cold Temperature

Suspect wood burning
Plume 2

Fullerene .6% of total BC

Coefficient values ± one standard deviation
a = 0 ± 0
b = 1.1279 ± 0.0376

Black Carbon µg/m³
Organic µg/m³
Nitrate equivalent mass (µg/m³)
MSSD Org +2.0560
MSSD NO3 +0.6891
MSSD SO4 +0.1937
MSSD lowc +2.3981
MSSD fullerene +0.0142

CO ppbv
Add. ON
Plume 2

Smaller particle size, lower coating

No wind

NO is very high in this plume up to 60 ppbv

Suspect local vehicular emissions
Plume 3

Fullerene 1.2% of total BC

Coefficient values ± one standard deviation
a = 0 ± 0
b = -0.87825 ± 0.0409
Plume 3

highest magnitude of Black Carbon of the 3 plumes we’ve looked at.
It has the least coating as a percentage of total.

Gas Phase compounds show comparitively little response.

Strong wind here from the NNE where the Thames estuary and associated shipping and industry are located
Comparing the 3 plumes
Conclusions

• The SP-AMS enabled the determination of the chemical structure of soot particles and their coatings as well as sizing information during the ClearFlo campaign.

• During the time period with the vaporizer removed a number of different plumes were detected with varying sources.

• Many more intercomparisons yet to do with HR-ToF-AMS, MOVI-CIMS, SP2, PASS.
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Research still to do with this data

Look at other soot plumes in detail as was done with these 3 plumes

Look at plumes in detail from the time period when the vaporizer was in (these measurements combine nonrefractory particle measurements and refractory particle measurements)

Look at the effect the thermal denuder has on the coating of these plumes

Do HR analysis of the black carbon particles in the 100-500 mz range (sort out conflicts with PAHs)

Compare to standard HR-ToF-AMS to get insight into % of soot particles relative to total particles