SPAMS at Manchester

Quick overview

Summary of SPAMS

Running for 2-ish years

Regal Black calibrations (based on CPMA work) RIE ~ 0.2 – 0.3

Laser power: ~ 0.8 (James A) – 1.7 (Paul W)

Alignment of laser seems robust, even after transporting SPAMS across Europe

V mode Pika seems adequate to get the Cx family peaks

Aquadaq calibrations (based on CPMA work) RIE ~ 0.024

Measured aircraft exhausts, ambient (London and Manchester), calebrants and diesel exhaust

Fullerenes everywhere, but quantification remains a challenge

Use SO Pika (m/z48) to calculate SO$_4$ total, rather than squirrel for laser on. In fact, I tend to use m/z48 for calculating total SO$_4$ with laser off applications as well.

Total organic time series from Org(tot, Hz)-FamilyCx(Hz, pika) then convert to mass
Beam profile generally ok

Have good alignment of the laser sweet spot and heater sweet spot. I DO NOT like trying to move the laser once aligned!
For calibrants and smog chamber, CPMA cycled through pre-programmed sizes and the SMPS scanned.

Calibrant:
CPMA cycled through pre-programmed sizes and the SMPS scanned. Once ED was calculated, the CPMA was fixed at one mass, SMPS one size and output fed to AMS. This removes any n=0 and multicharged peaks. All ran through CS, some without.

Smog chamber:
As above for SMPS and CPMA, taking both stripped and un-stripped. AMS sampled the chamber, either stripped or un-stripped.

Ambient:
Same as chamber, but automated the process so valve switched hourly.
Comparing the fragmentation of RB with diesel soot – all the same

Comparing the fragmentation of RB with ambient data
Aquadaq, Regal Black and aircraft exhaust fragmentation. Despite the low sensitivity of the SPAMS to aquadaq, fragmentation patterns are the same.

Heater on issues – need two AMS??

Particles the same size

- Laser on, heater on: ‘Everything’, but no coating information
- Laser off, heater on: Just organic, no coating information
- Laser on, heater off: Just BC core particle and coating
With heater on all the time, cannot use standard ‘normalise to ms’ for ambient PToF data. Normalising would increase/decrease the signal at all sizes, needs to be just at the BC mode.

Not measured with heater off

Any externally mixed organics cannot be separated with heater on

Fullerenes – now you see them (logging)
Apply corrections – now you don’t!

Can’t get a good m/z cal at high m/z – ongoing issue. Also, there are a lot of $^{13}\text{C}$ peaks in there*

*I haven’t spend much time with this, I was waiting for feedback from AMSUsers. Therefore, there could be idiocy a-foot!
Collection efficiency

Current BC calibrations use a CPC for a concentration and a mass per particle to get RIE and assumes SPAMS sees all particles. So RIE is actually an inherent collection efficiency corrected RIE. For laser off IE is based on BFSP.

RIE of RB is 0.2 (Onash); RIE of Aquadaq is 0.024. Is that because the true RIEs are different or the collection efficiencies are different? What does this mean for ambient?

1) Has anyone used a CPMA on ambient data to get the ED and then do a SPAMS cal to compare with RB for example? What about CPMA on nitrate and then a cal and compare with BFSP?
2) Need BFSP for RB to get the true RIE

Collection efficiency example: m/z 57 is a BC free peak
Compare a laser on/heater on with laser off/heater on (no CE applied)

This is aircraft exhaust, so all particles will be BC core coated in organics (probably). Therefore is the factor 0.46 the heater CE as the laser CE is applied via the RIE_{BC}?

CPMA Work
RB gives largest signal in SPAMS, good BFSP data. Fullerenes 2nd highest, some BFPS. Aquadaq very little and no BFPS particles.

The non-stripped diesel particles have a coating, hence different ED. BUT the calibrants are a little worrying. Either there is contamination (Nebuliser was thoroughly cleaned), or the CS (~350C) changes morphology. If the former, then a 350nm particle, say, from a SMPS coated with organic does not have the same mass per particle as a solid 350nm BC particle i.e all calibrations need some sort of denuder. If the latter, then how do you ensure complete removal of organics to get a true ED? CPMA gives constant mass, whether it be pure BC or coated BC.
Particle transmission modification?

Coefficient values ± one standard deviation

\[ a = 0.098744 ± 0.00702 \]
\[ b = 0.28918 ± 0.0135 \]

Solid = High SPAMS/Aeth ratio
Dotted = Low SPAMS/Aeth ratio