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

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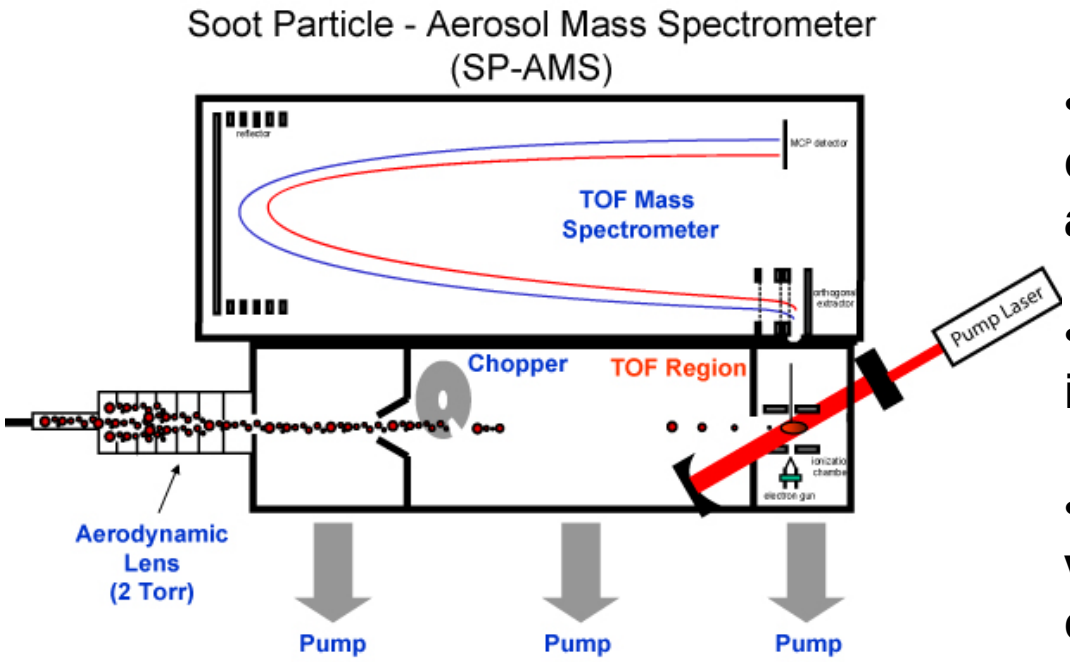
Soot Particle Aerosol Mass Spectrometer (SP-AMS)

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

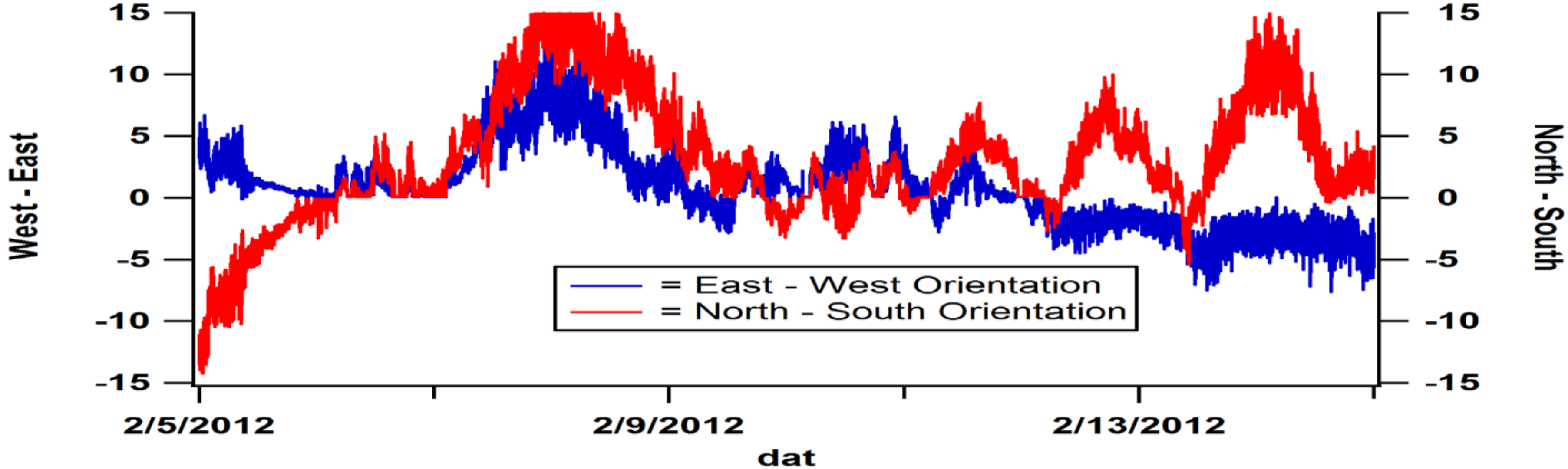


- **Composition of the refractory component of submicron aerosol**
- **Laser incandescence + EI ionization + mass spectroscopy**
- **Only refractory particles are vaporized in laser (soot core + coating)**
- **Conventional vaporizer may be left in or removed**

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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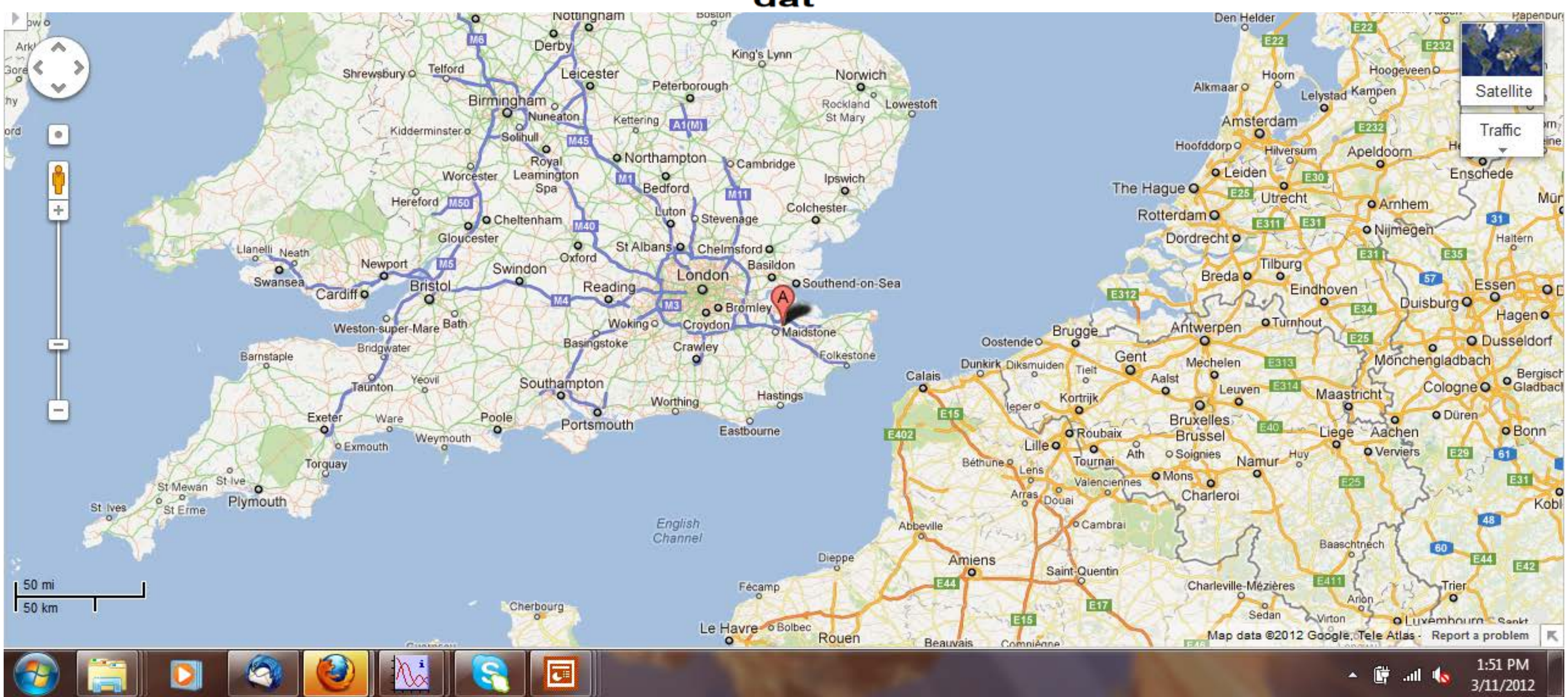
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Southampton
Portsmouth
Reading
Oxford
Swindon
Bristol
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Plymouth
Torquay
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Brugge
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Bruxelles Brussel
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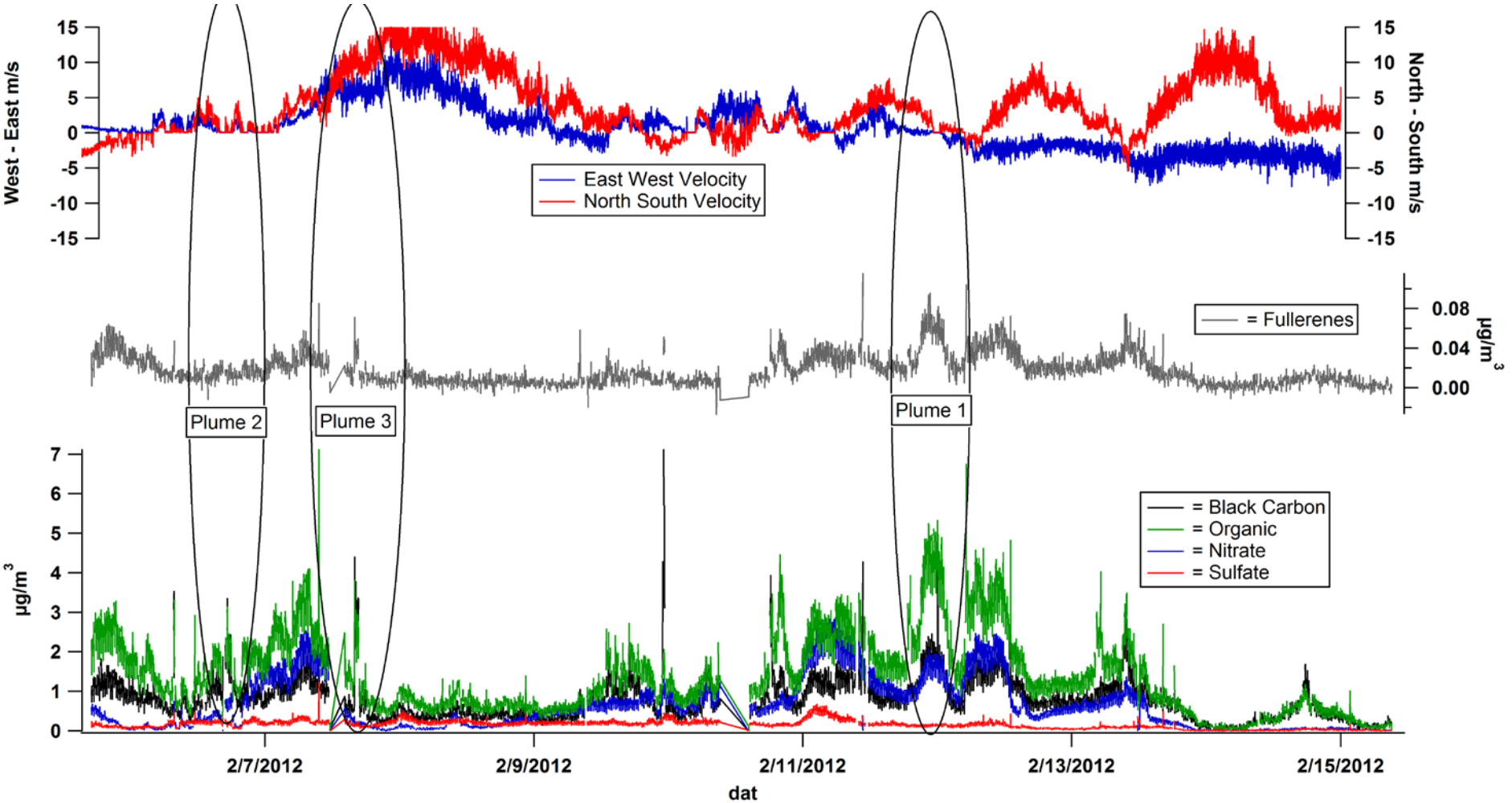
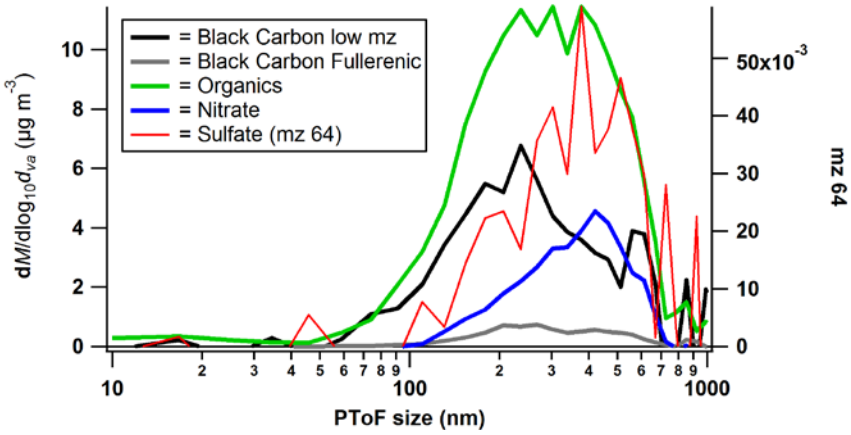
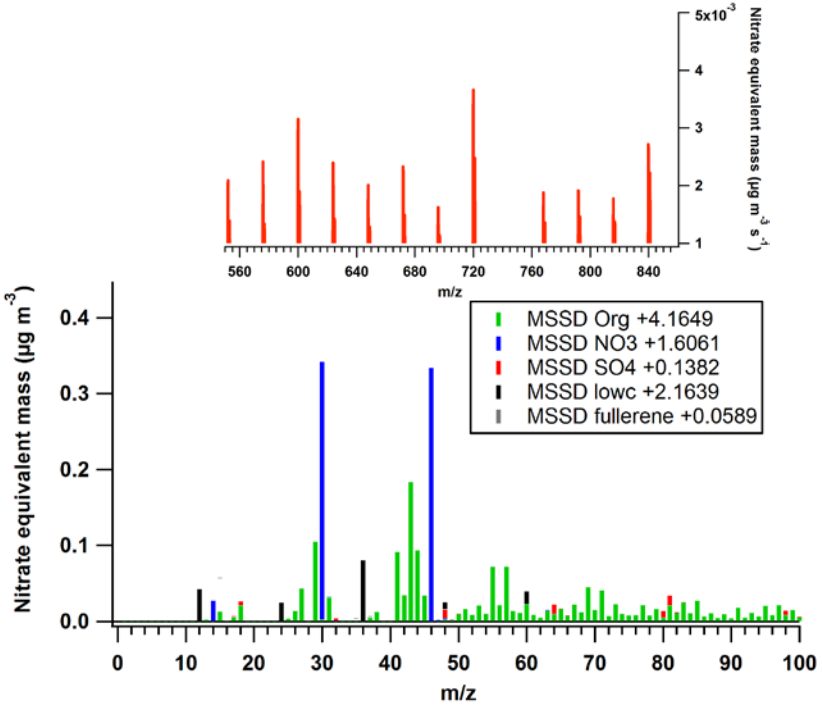
We can focus on individual plumes with the goal of determining their source

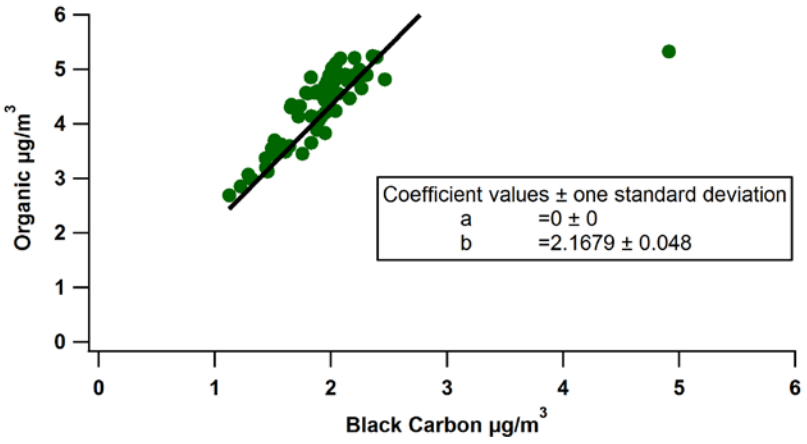


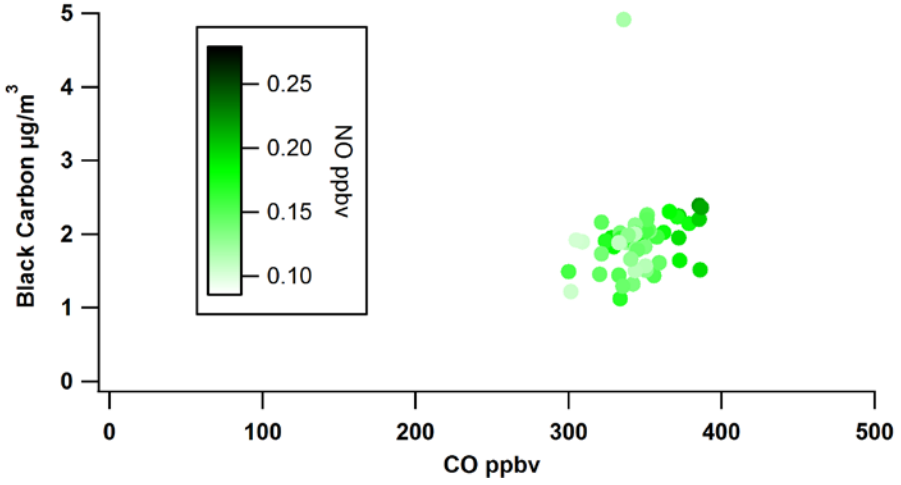
Fullerene 2.7% of total BC

Plume 1









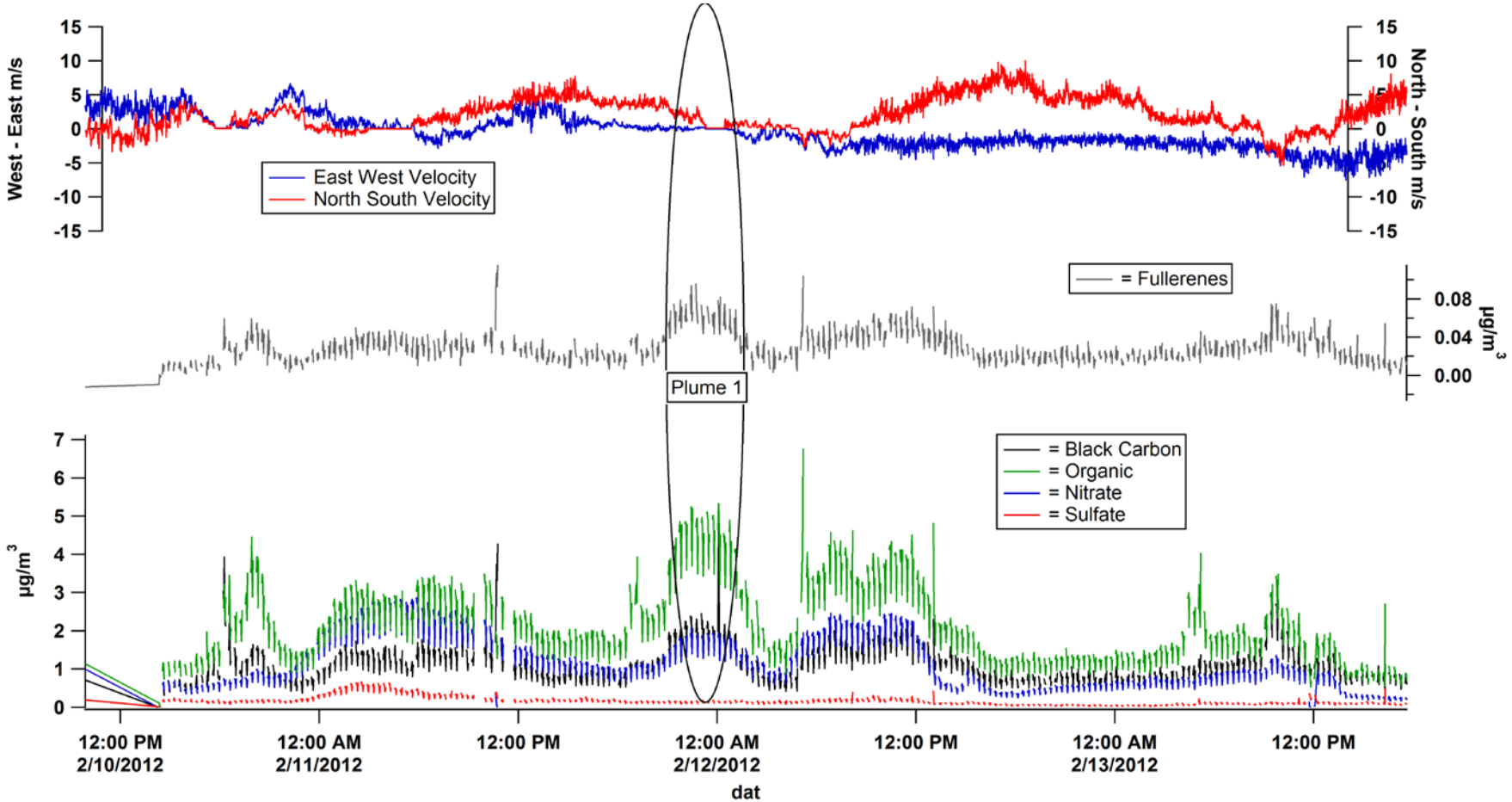
Plume 1

high coatings of organics, high fullerenes

No wind

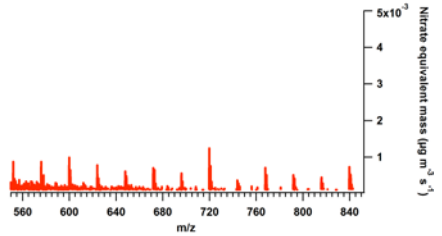
Cold Temperature

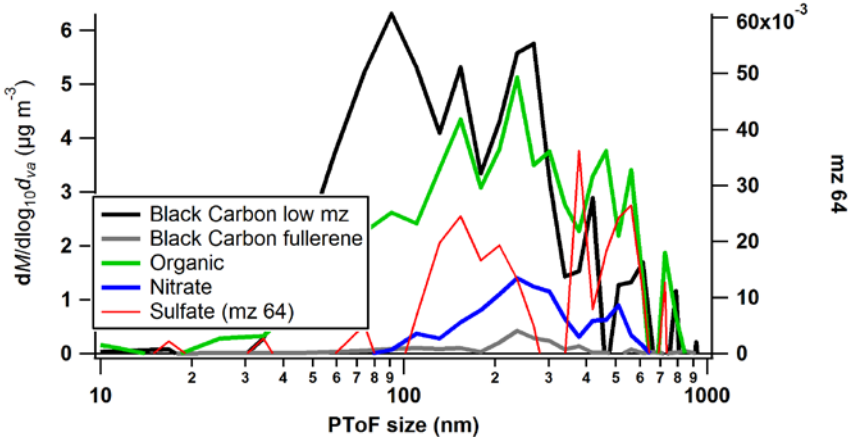
Suspect wood burning

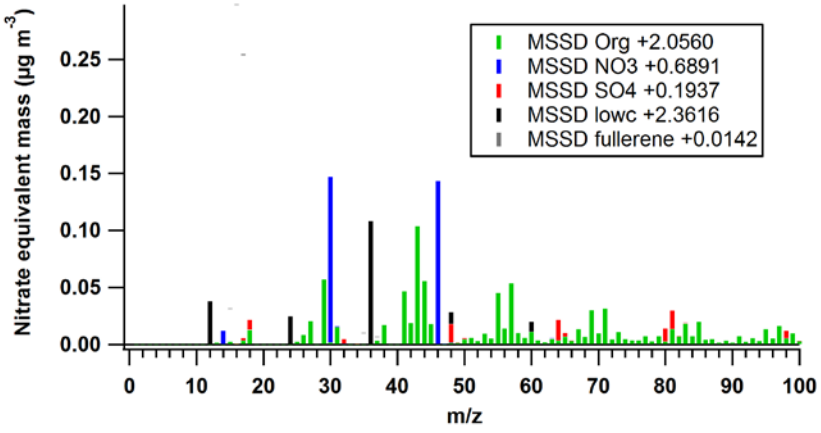


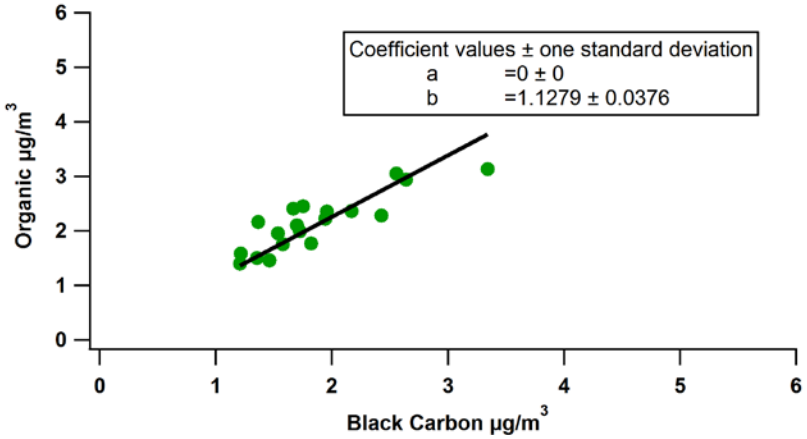
Fullerene .6% of total BC

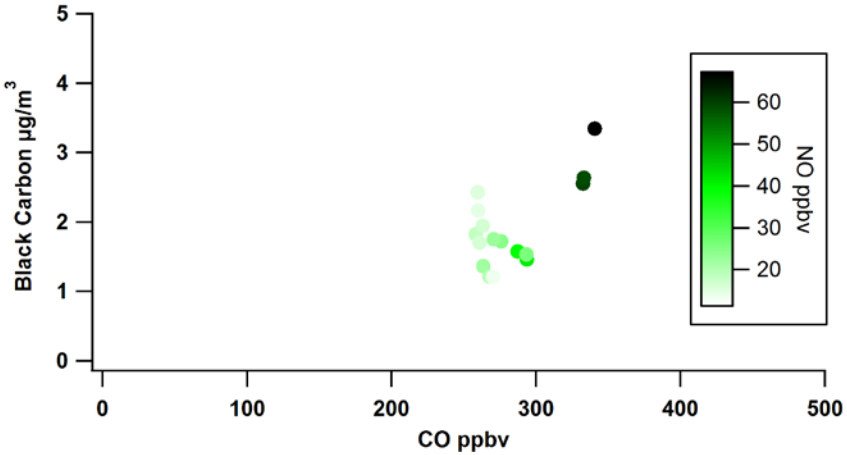
Plume 2











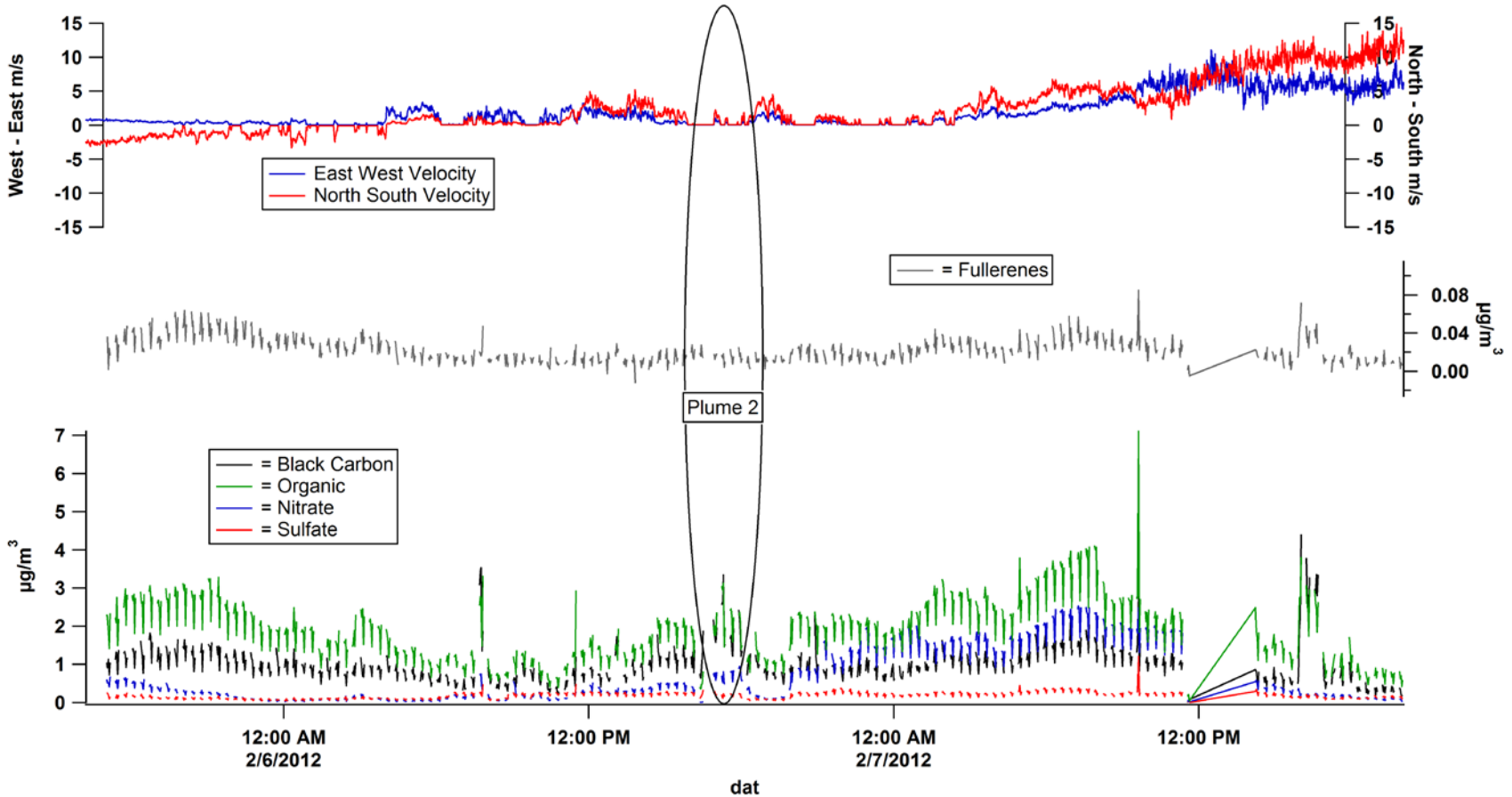
Plume 2

Smaller particle size, lower coating

No wind

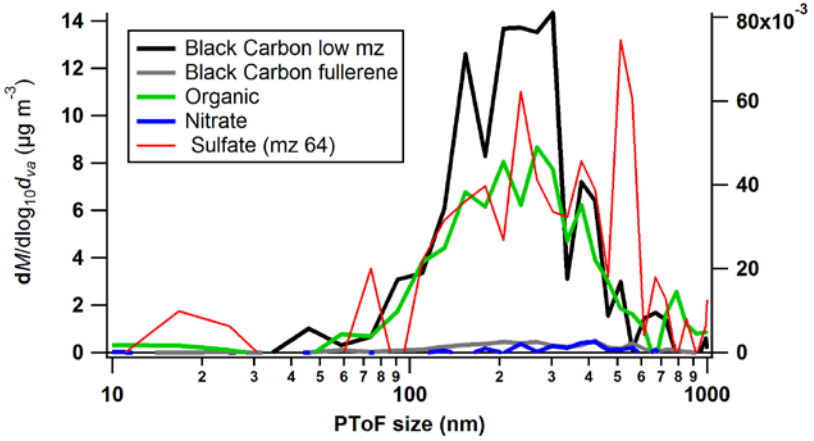
NO is very high in this plume up to 60 ppbv

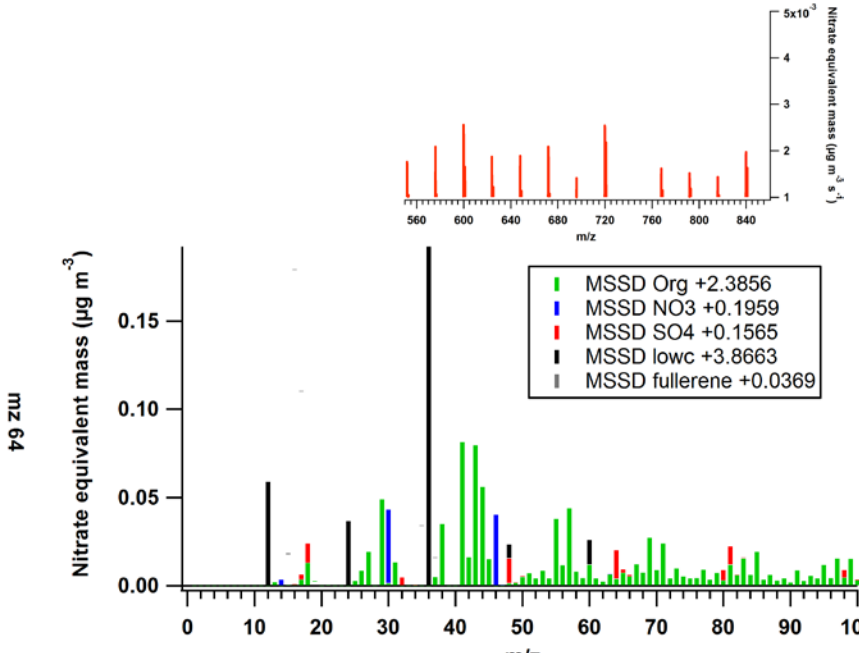
Suspect local vehicular emissions

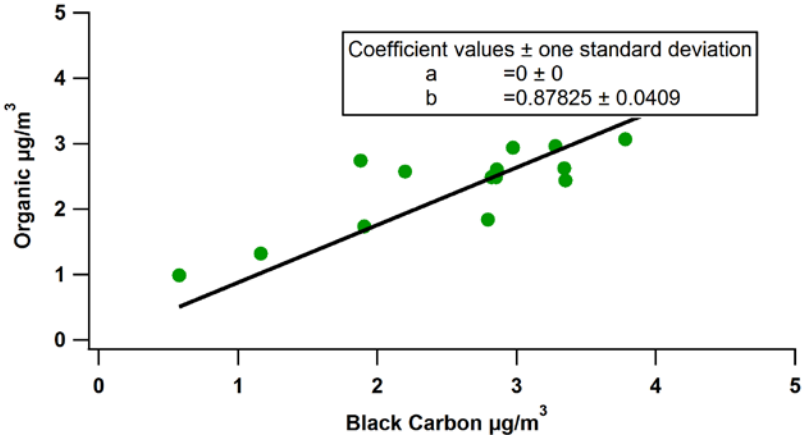


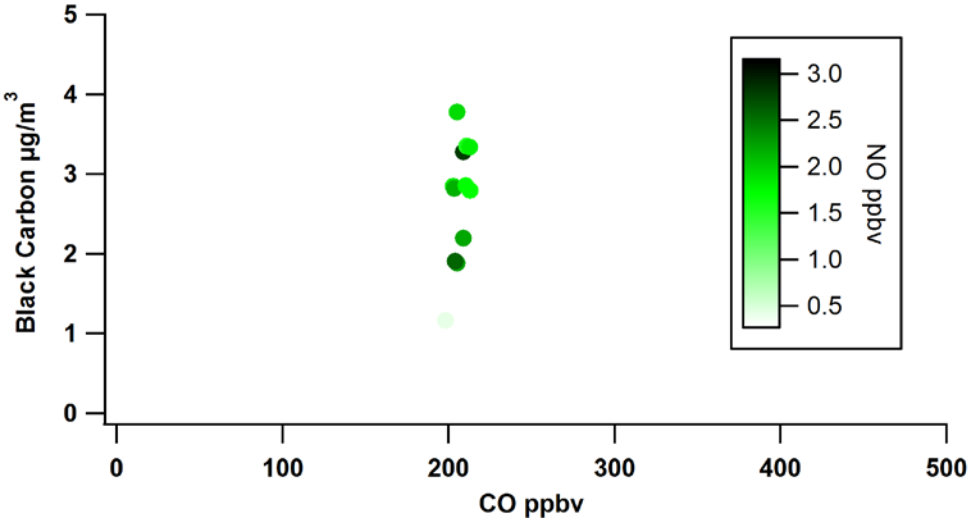
Fullerene 1.2% of total BC

Plume 3









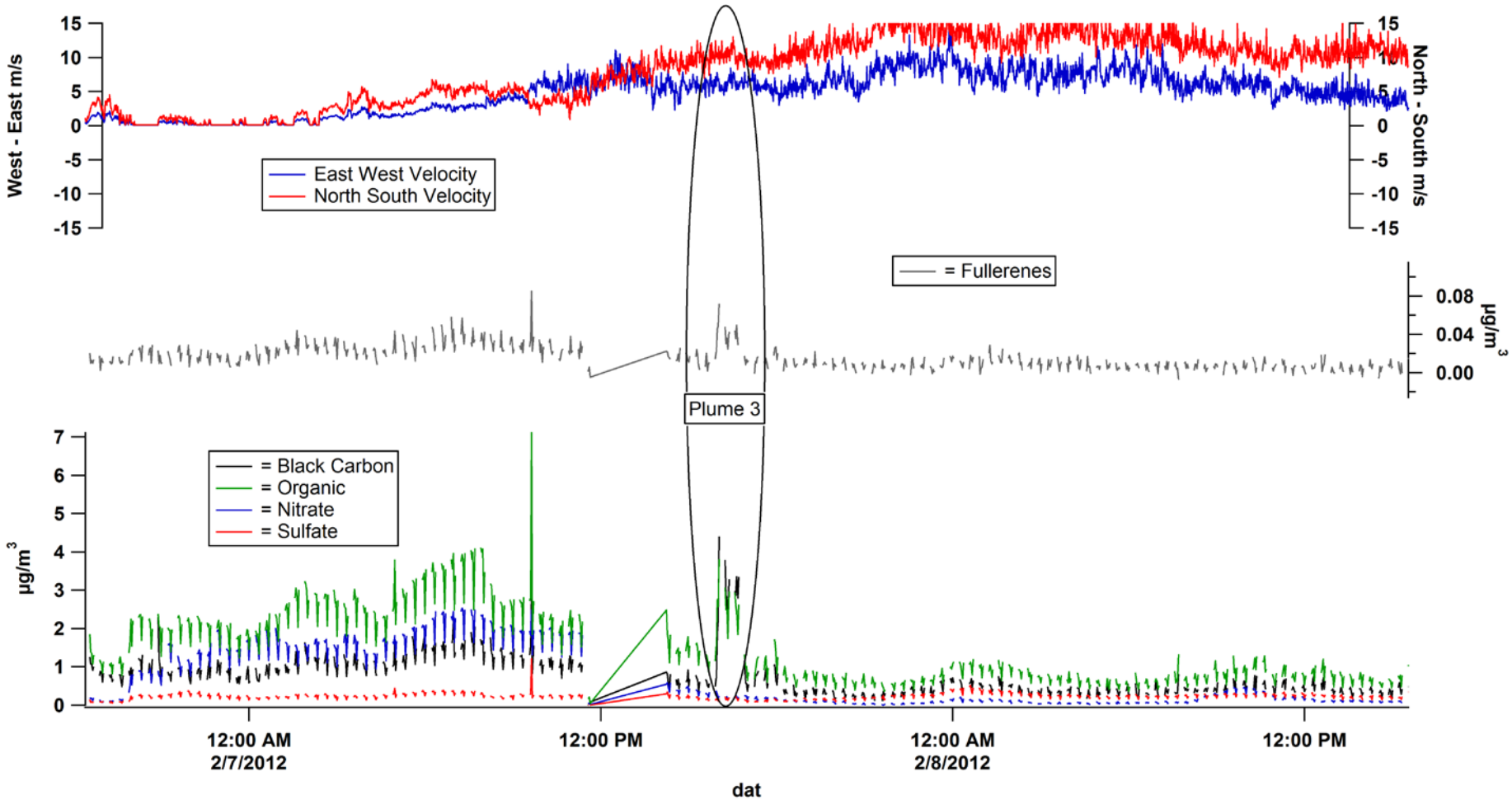
Plume 3

highest magnitude of Black Carbon of the 3 plumes we've looked at.

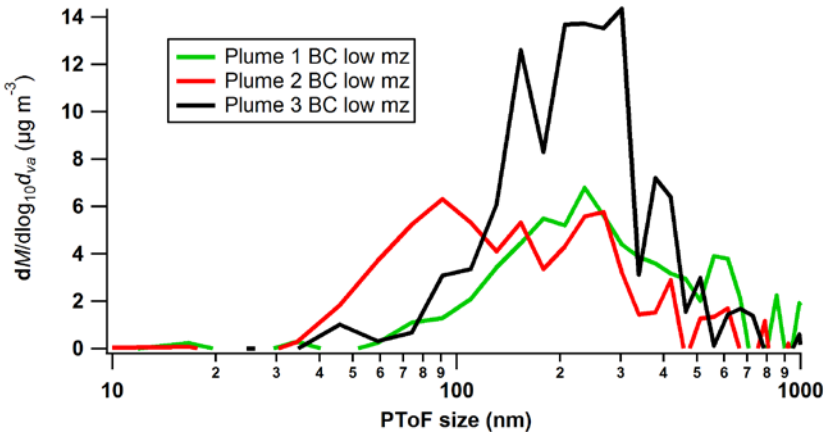
It has the least coating as a percentage of total.

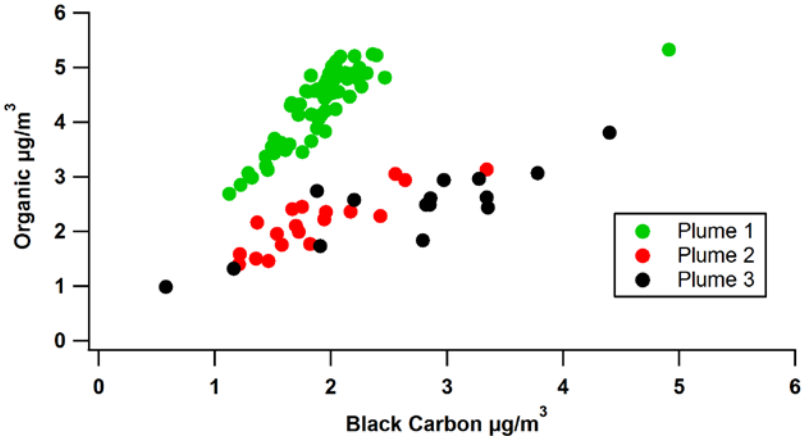
Gas Phase compounds show comparitively little response.

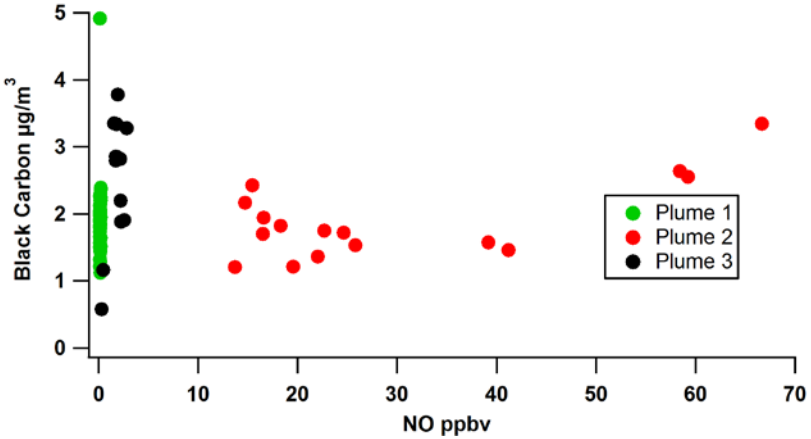
Strong wind here from the NNE where the Thames estuary and associated shipping and industry are located

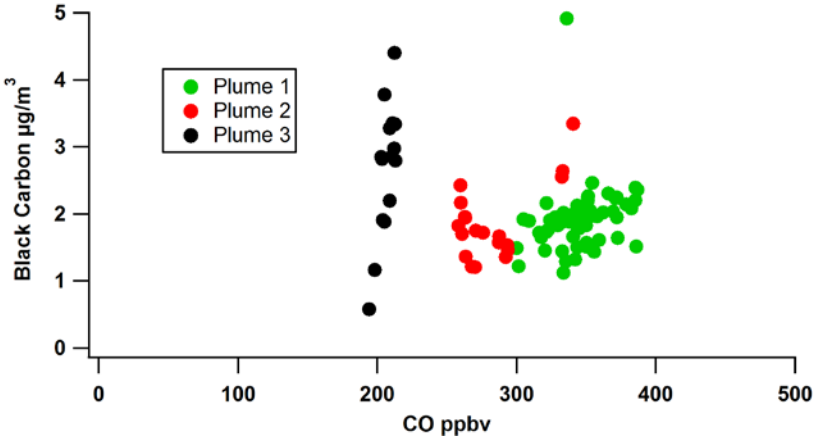


Comparing the 3 plumes









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

Acknowledgments

- Thanks to fellow participants from University of Washington, Los Alamos National Laboratory, Argonne National Laboratory for the help at the site
- Thanks to DOE Atmospheric System Research for funding
- Thanks to the UK NERC for logistical support

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