

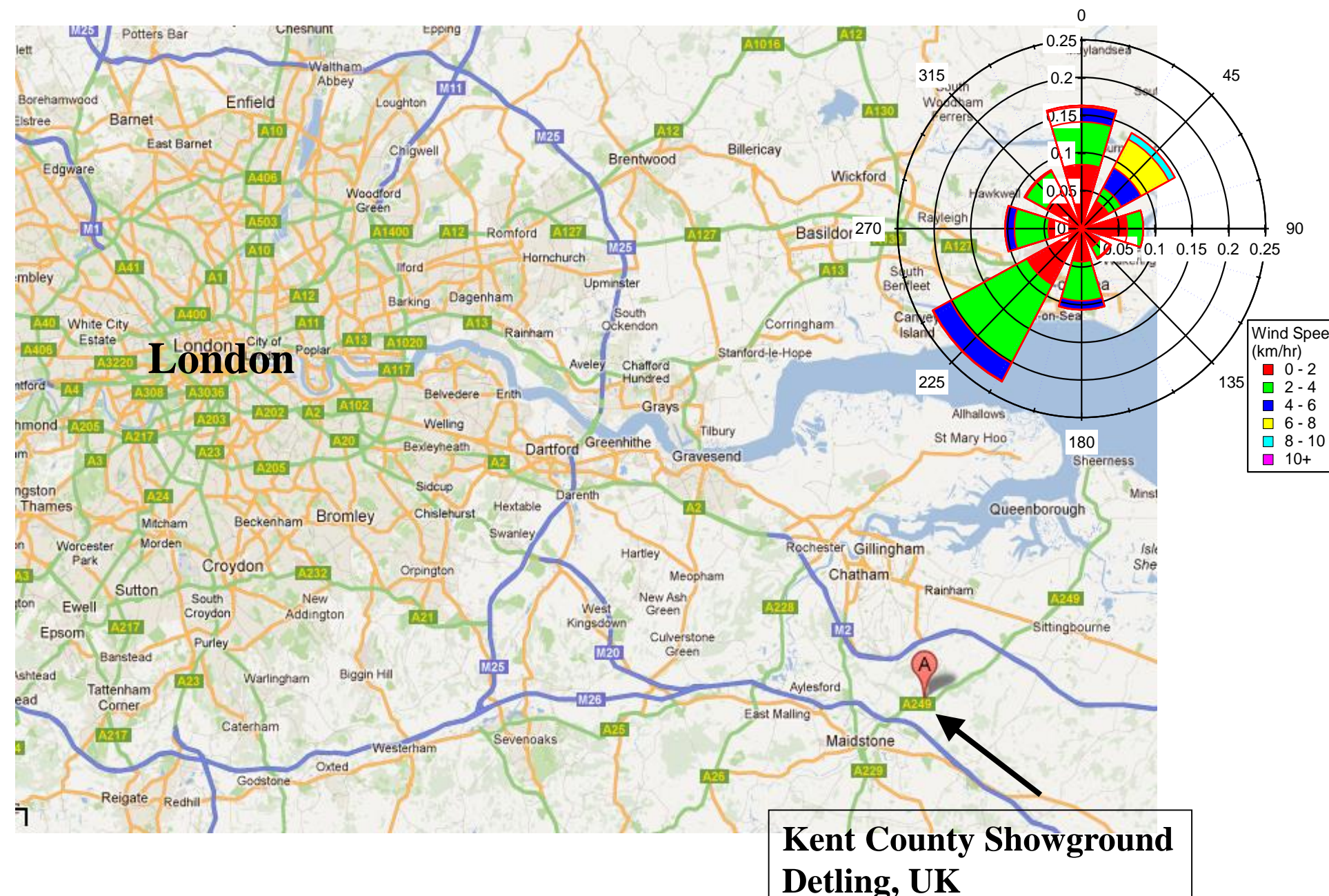
Sources and Atmospheric Processing of Black Carbon-Containing Particles at a Rural Site

Southeast of London, January-February, 2012

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Clean Air for London (ClearLo) Winter Intensive Detling Site (Jan-Feb 2012)



- Study of London air pollution at an urban street site, an urban background site and rural sites in order to understand transport and aging of the urban plume.
- We provided an extensive suite of instruments at the rural site SE of London in Detling, UK.
- During the one month deployment, we sampled London outflow, continental outflow and local pollution sources.
- Goals::
 - Understand air mass sources and aging, and correlations with London urban measurements.
 - Provide closure between optical properties and chemical composition, including black carbon.
 - Measure absorption enhancement by coatings on black carbon.

Instruments at Detling:

Gas-Phase Measurements:

- NO, NO₂, NO_x, O₃, N₂O, CO₂, CO, NH₃, HCHO
- PTR-MS and GC/FID: VOC's
- MOVI-CI-ToF (oxygenated HC's)

Particle Measurements:

- HR-ToF-AMS, SP-AMS
- MOVI-CI-ToF (organic acids)
- SMPS, LAS
- Thermal Denuder

Particle Black Carbon:

- SP-AMS, MAAP, SP2, aethalometer

Particle Optical Measurements:

- CAPS PMex (red and blue), PASS-3

Bulk Particle Measurements:

High volume filter sampler, rotating drum impactor, SEM filter collector

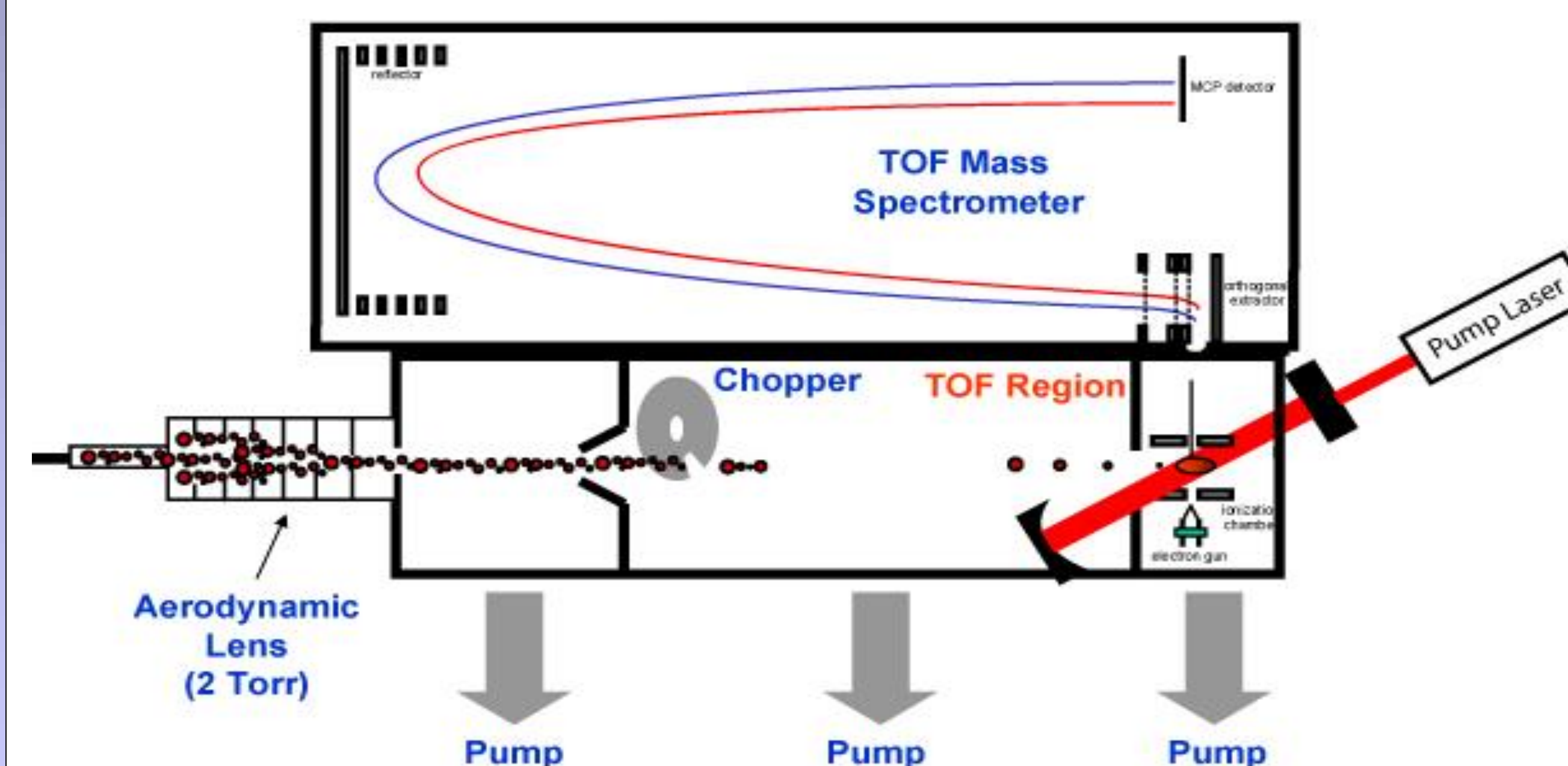
Remote Sensing:

- Micro Pulse LIDAR
- Radiometer
- SODAR Wind Profiler
- Surface met

Acknowledgements:

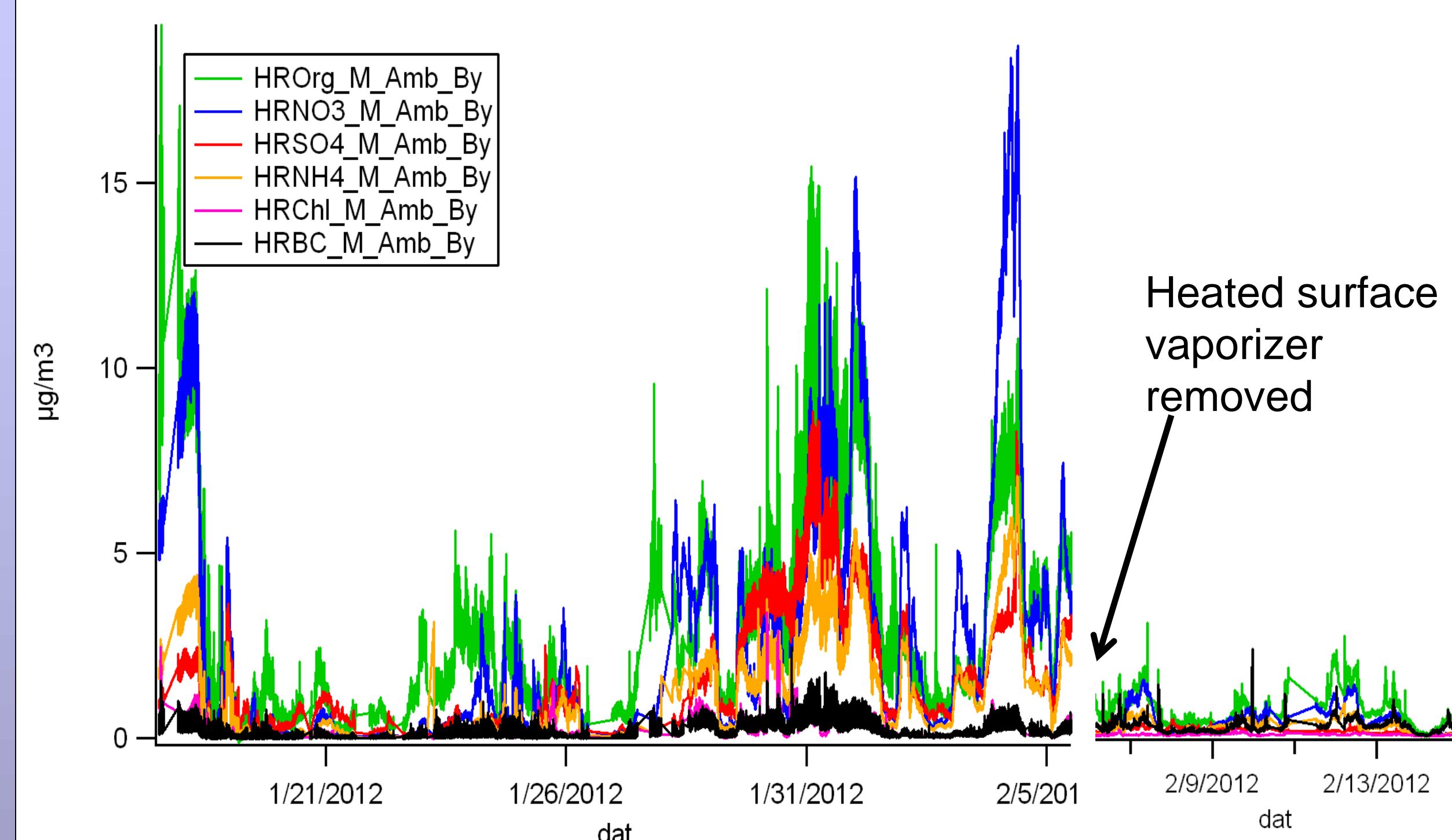
- US DoE Atmospheric System Research Program
- UK Natural Environment Research Council

Soot Particle Aerosol Mass Spectrometer (SP-AMS)



Combines DMT Single Particle Soot Photometer (SP2) and Aerodyne High-Resolution Aerosol Mass Spectrometer (HR-AMS)

- Thermal vaporization on heated surface of non-refractory PM1.
- Laser vaporization of refractory black carbon (rBC)
- High resolution mass spectrometry of coatings and rBC.
- Use chemical composition of coatings on rBC-containing particles to identify sources



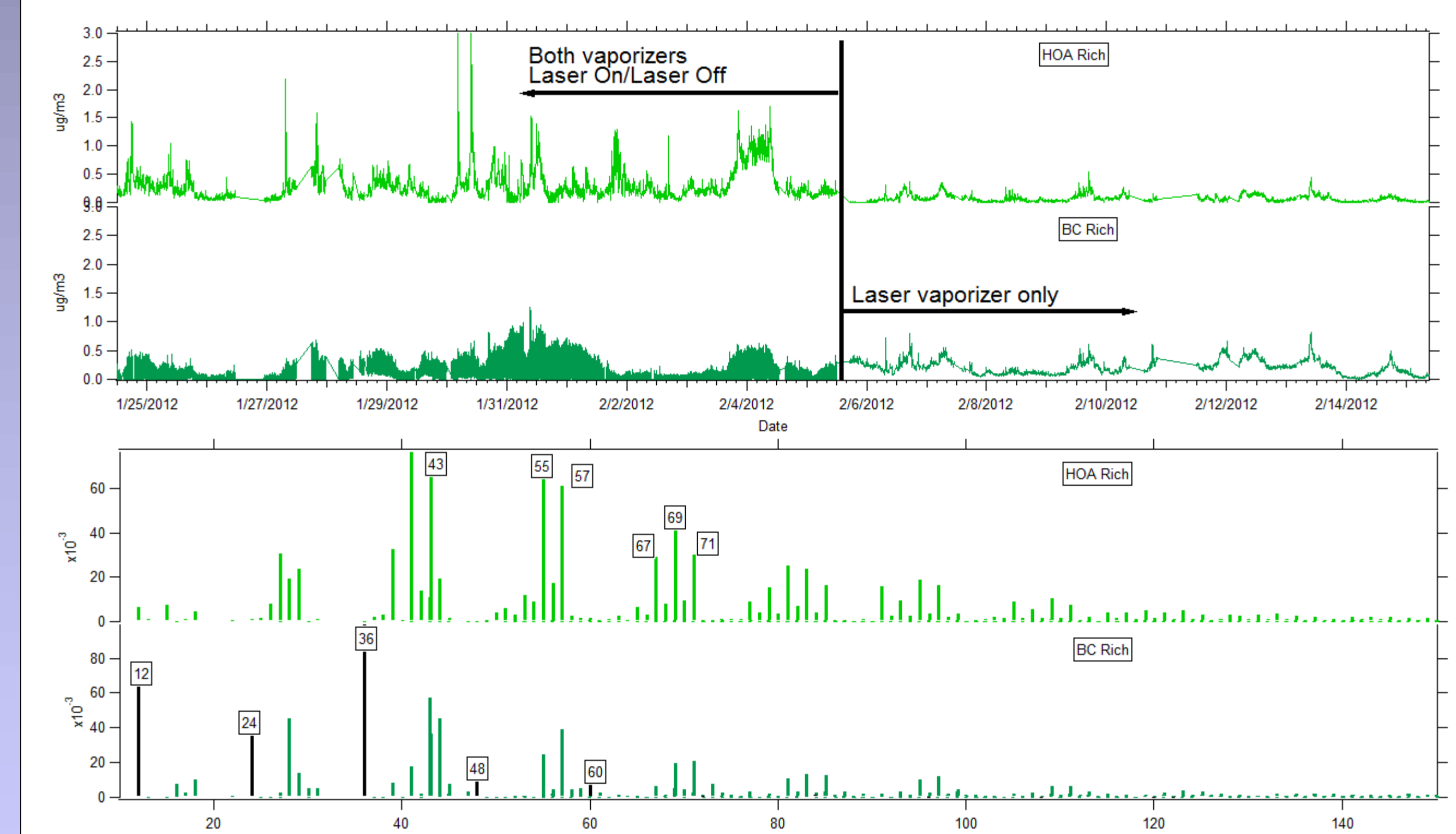
Campaign Overview of SP-AMS Data

- 17 Jan to 5 Feb: Both vaporizers, switching laser on/off, measures all non-refractory PM1 plus rBC.
- 5 Feb to 15 Feb: Laser vaporizer only measures only rBC containing particles plus coatings.

Positive Matrix Factorization (PMF) on Organic Mass Spectra

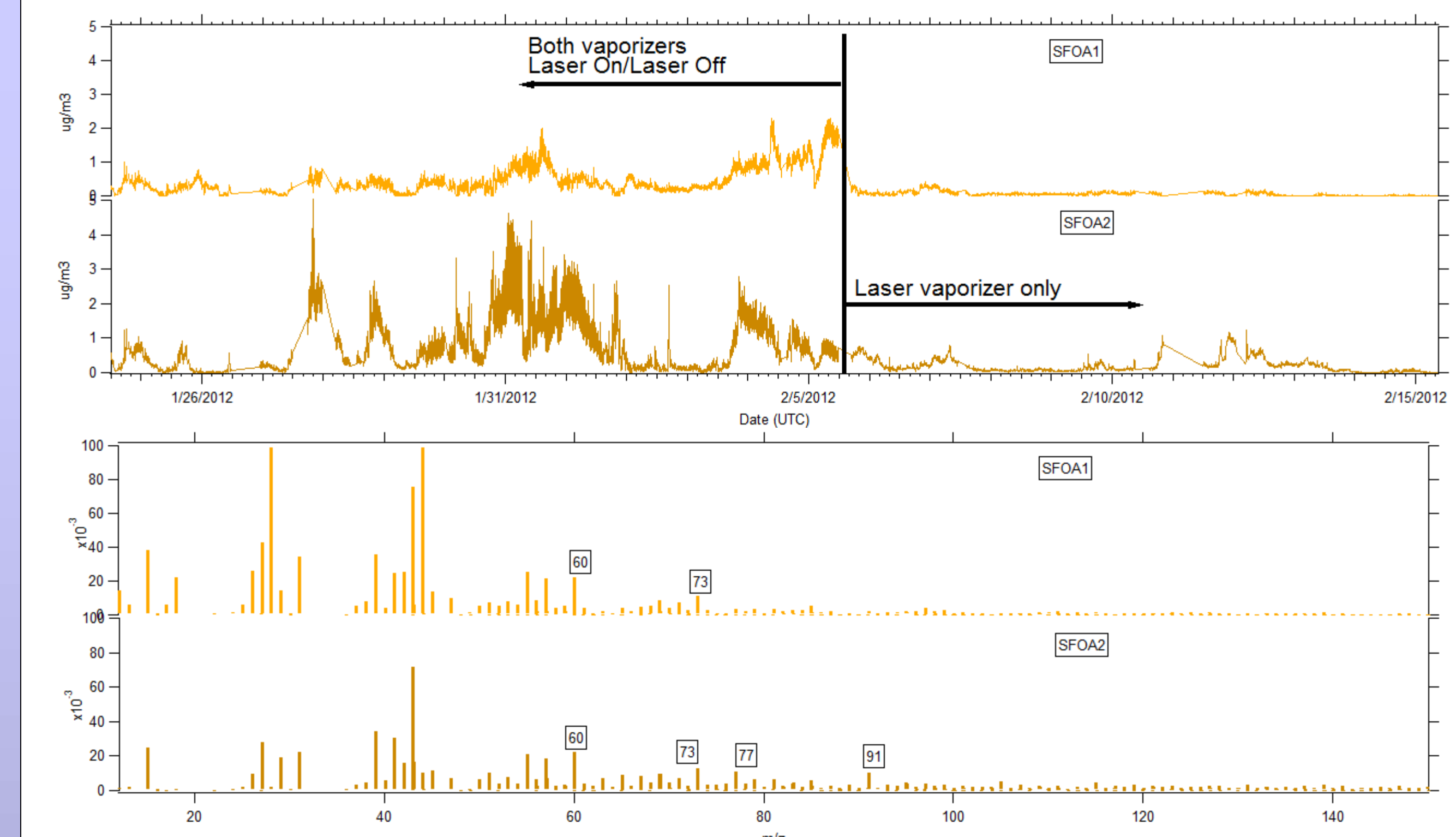
- Determines chemical signatures that co-vary in time.
- Correlate with other measurements (e.g., gas-phase species, met data, reference spectra) to determine sources.
- PMF on all three modes of operation (both vaporizers laser on and laser off, laser vaporizer only).

PMF Results



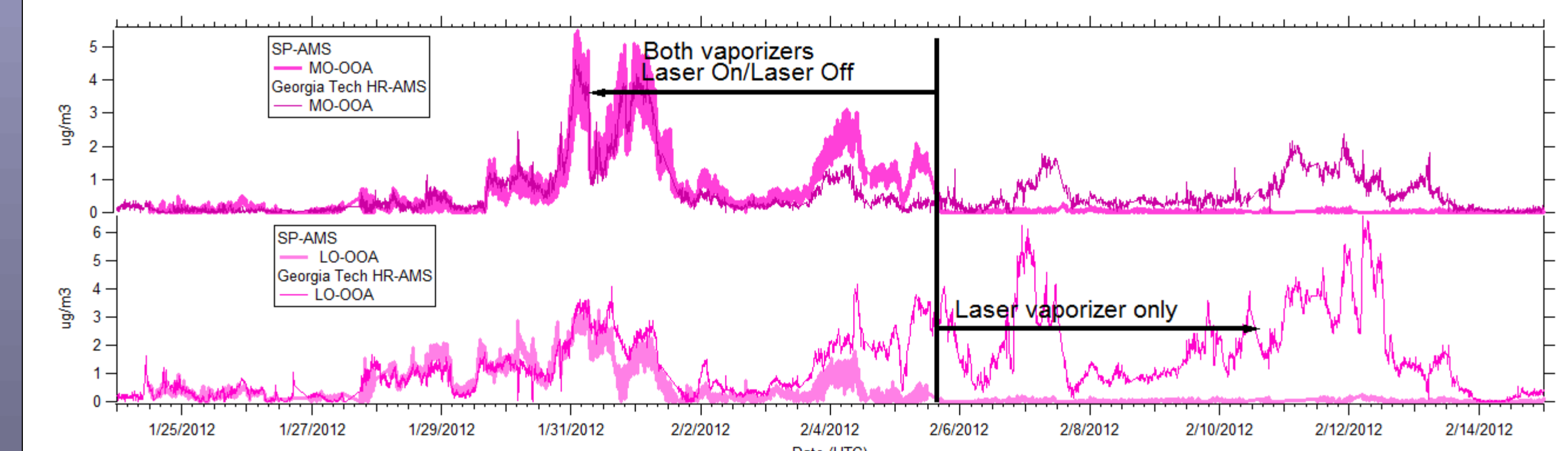
Hydrocarbon-like Organic Aerosol (HOA)

- Associated with vehicle emissions.
- ~ 50% of HOA contains rBC, of rBC-containing HOA, ~ 70% rBC rich.



Solid Fuel Organic Aerosol (SFOA)

- Associated with domestic home heating, agricultural burning.
- Two different SFOA factors – SFOA2 more likely to be associated with rBC, less volatile (based on thermal denuder measurements.)
- Different fuels? Different flame type? Different atmospheric processing?



Oxygenated Organic Aerosol (OOA)

- Associated with longer range transport.
- < 10% of OOA contains rBC