Chebogue Point 2004 Aerosol Measurements

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University of Manchester (UK)

Boston College
University of Essex (UK)
Environment Canada

Quick tour of the trailer…

Aerosol Mass Spectrometer

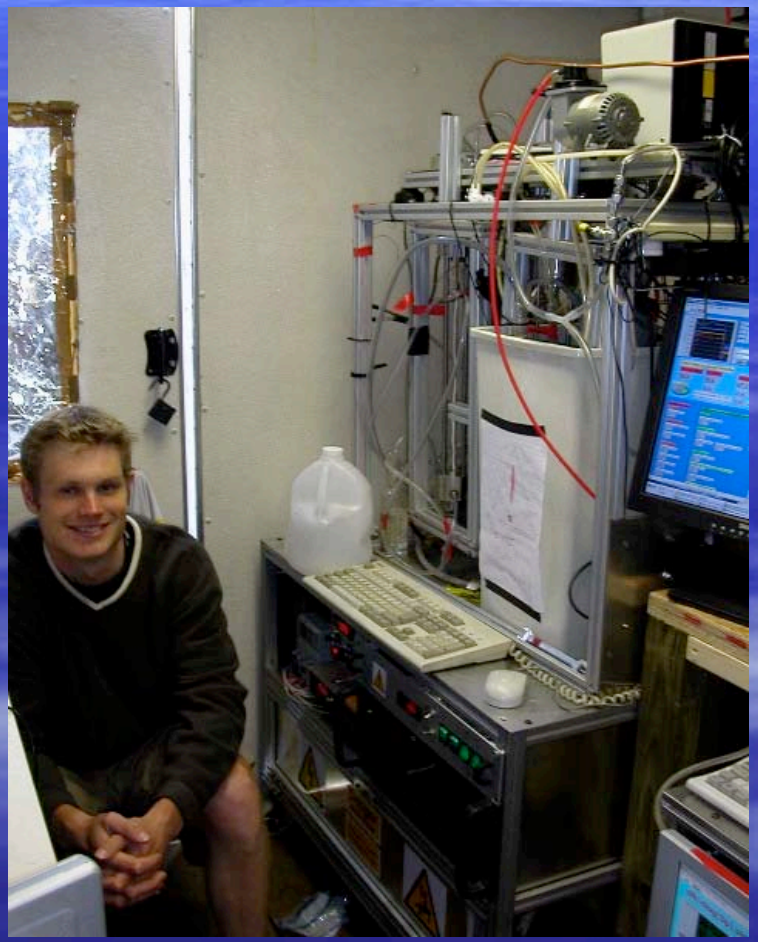
- Size-resolved non-refractory composition at a high time resolution
- Had a light scattering probe in the chamber
  - Additional counting and sizing
  - Scattering properties
- Thermal denuder
  - On an automated switching valve system, alternating between ambient and a user-defined temperature, upstream of an activated charcoal denuder

Differential Mobility Particle Sizer & Volatility Tandem DMA

- VTDMA
  - Measured size distributions from a single mobility size cut (170 nm), after exposure to three temperatures (cabin, 130 & 300 °C)
  - The particle volume is classified as volatile, semi-volatile or refractory based on these measurements
- DMPS
  - Two DMAs, operated on a stepping programme
  - Size-resolved number concentrations from mobility diameter 3 to 800 nm

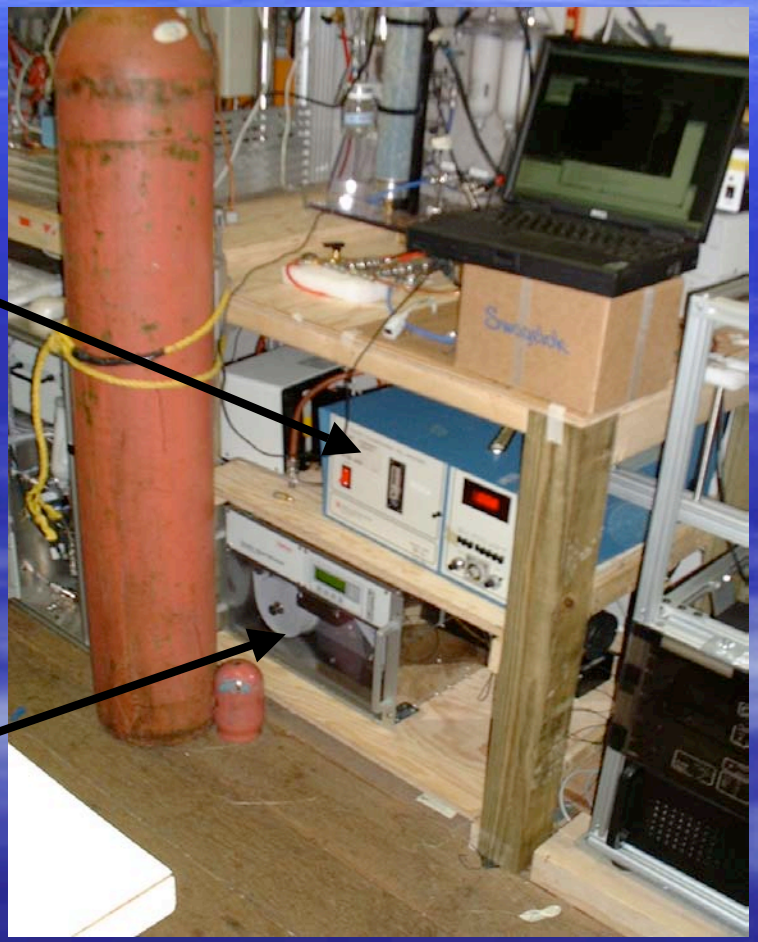
Hygroscopicity Tandem DMA

- Measured growth factor spectra at 90 % RH
- Used 3 dry mobility diameters for this project (40, 89 & 217 nm)
- Also recorded humidograms
- OEM retrieval used during data analysis



Multi Angle Absorption Photometer & SO_2

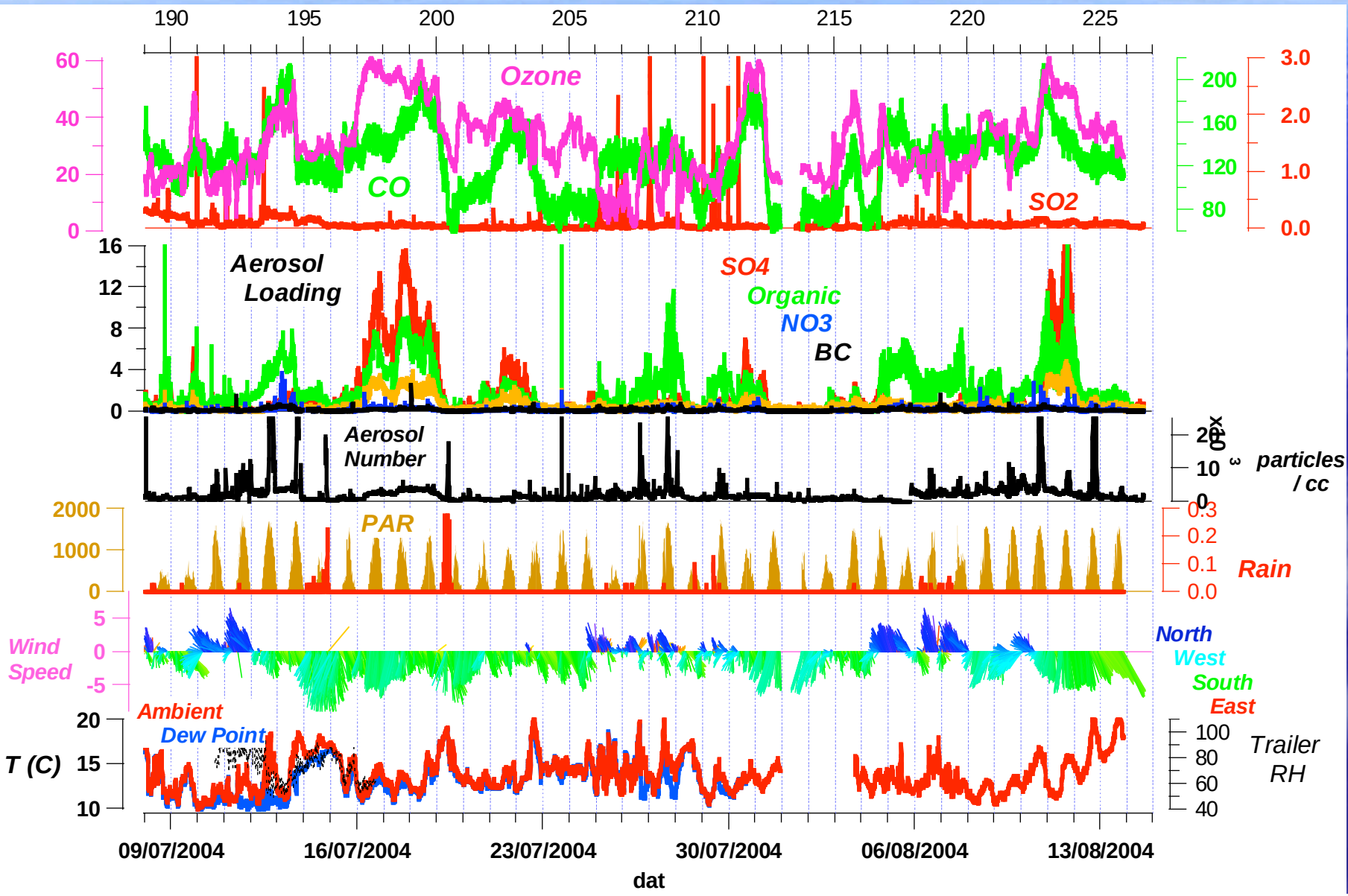
- SO_2
  - Thermo Electron model, as used in automated stations worldwide
- MAAP
  - Measures mass concentration of black carbon
  - Eliminates artefacts caused by scattering from sample or matrix



Data Status

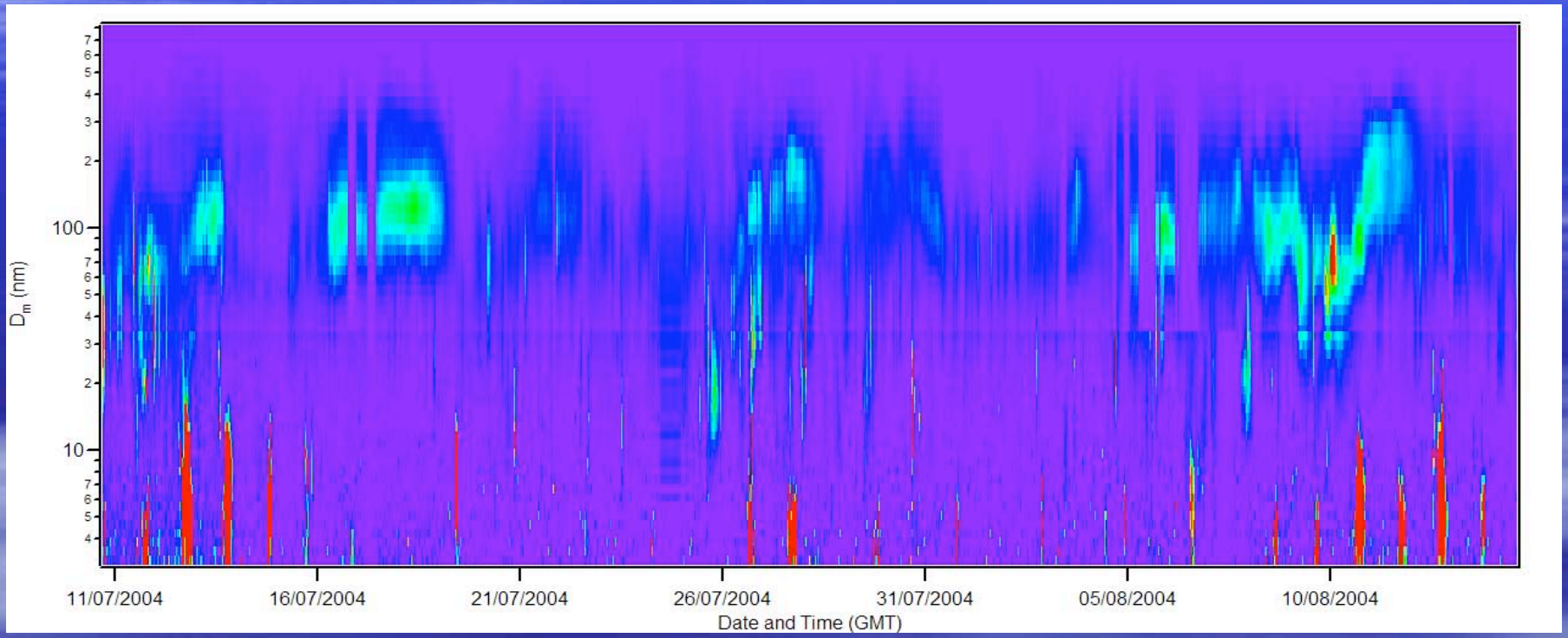
- Everything is ready to roll, except for the NH_4 and SO_2, which need a little tweaking.
- Everything currently on the NOAA ftp site is pretty much valid

Measurement Overview

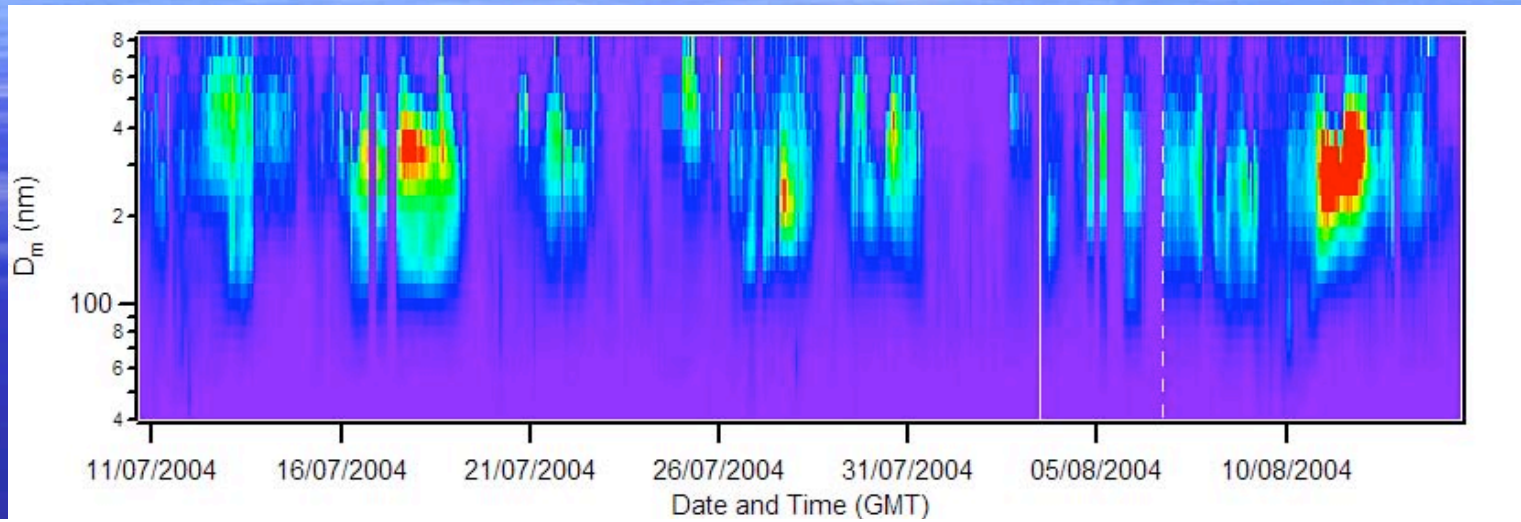


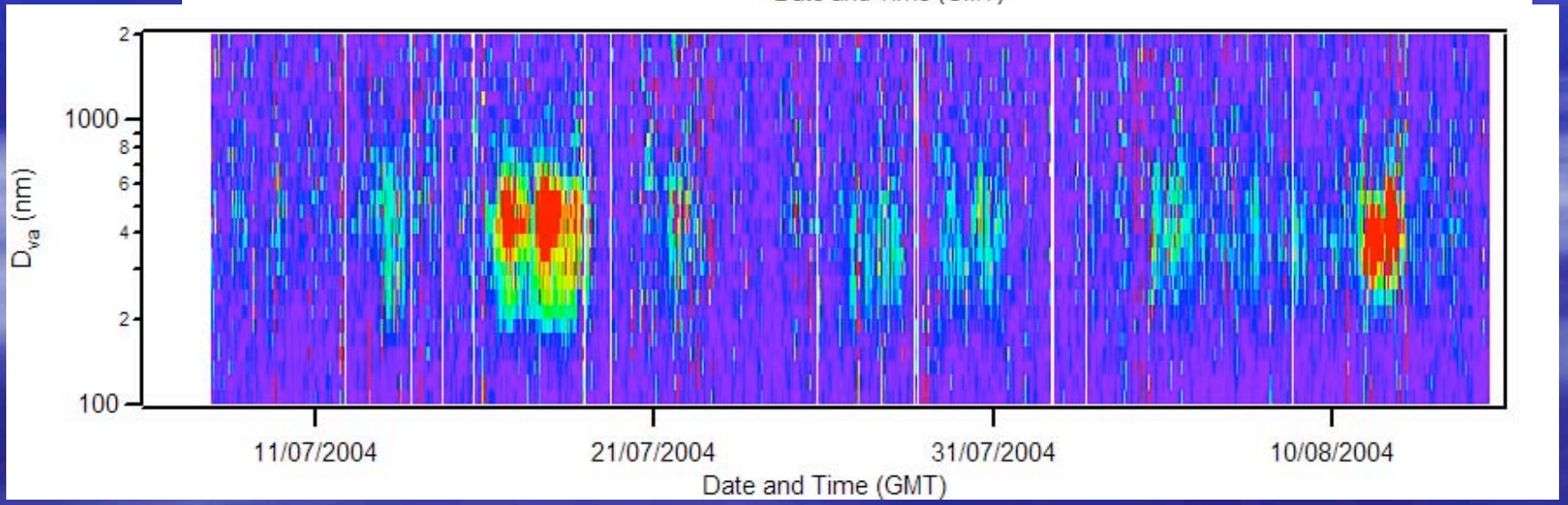
Size distributions

- Number

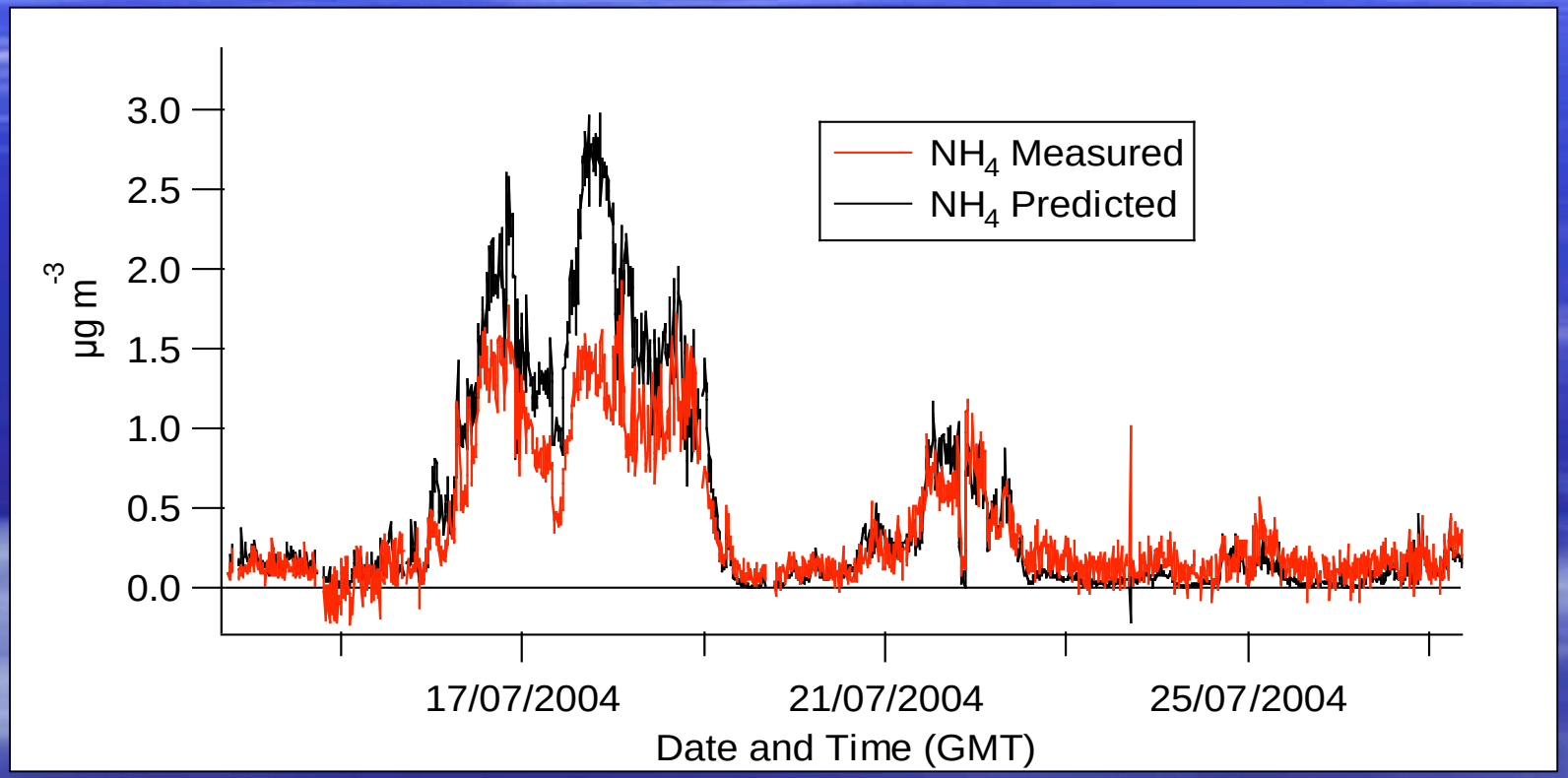


Volume & mass

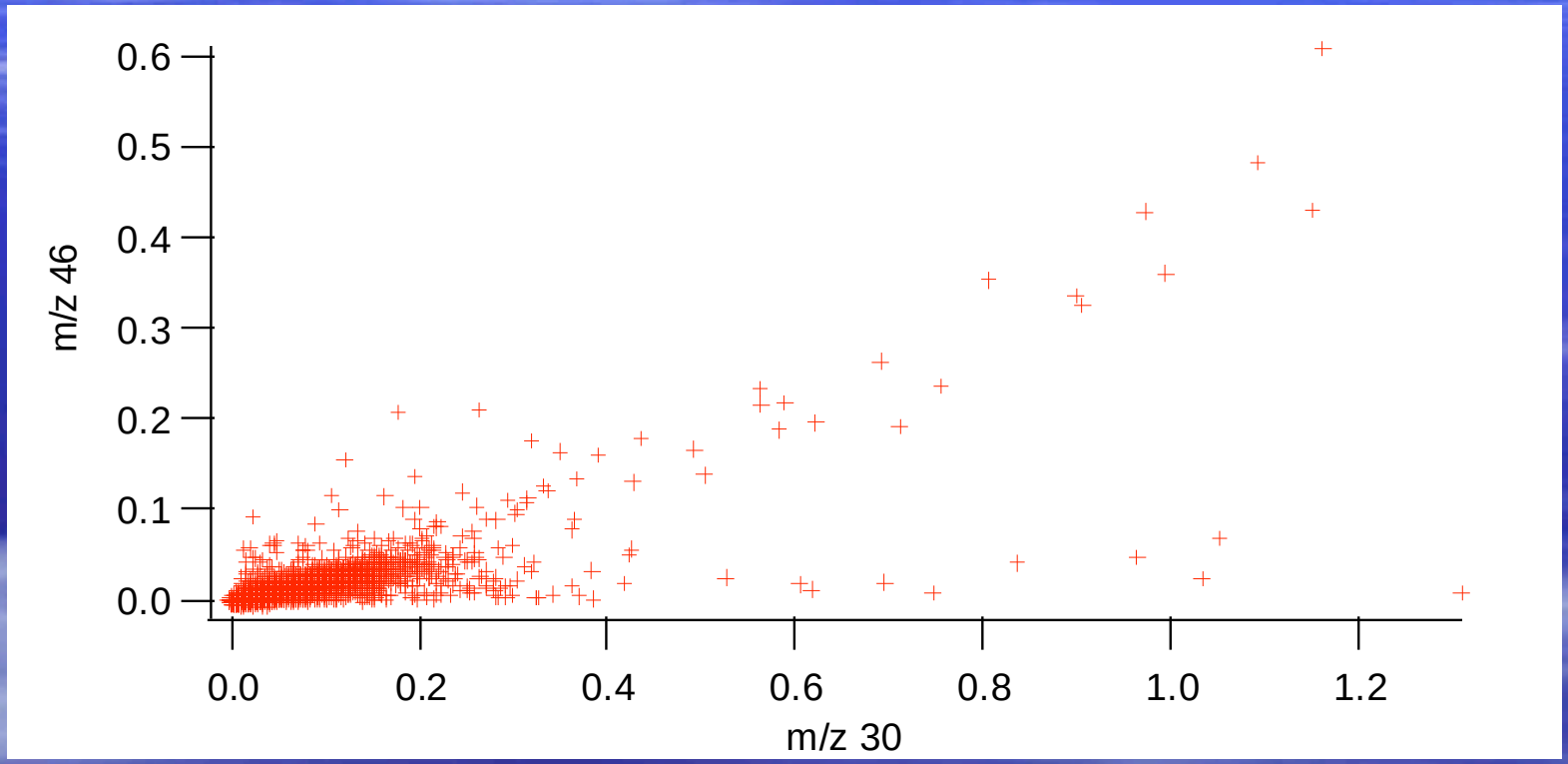

D_m (nm)
8
6
4
2
100
8
6
4
11/07/2004
16/07/2004
21/07/2004
26/07/2004
31/07/2004
05/08/2004
10/08/2004
Date and Time (GMT)


D_{va} (nm)
2
1000
8
6
4
2
100
11/07/2004
21/07/2004
31/07/2004
10/08/2004
Date and Time (GMT)

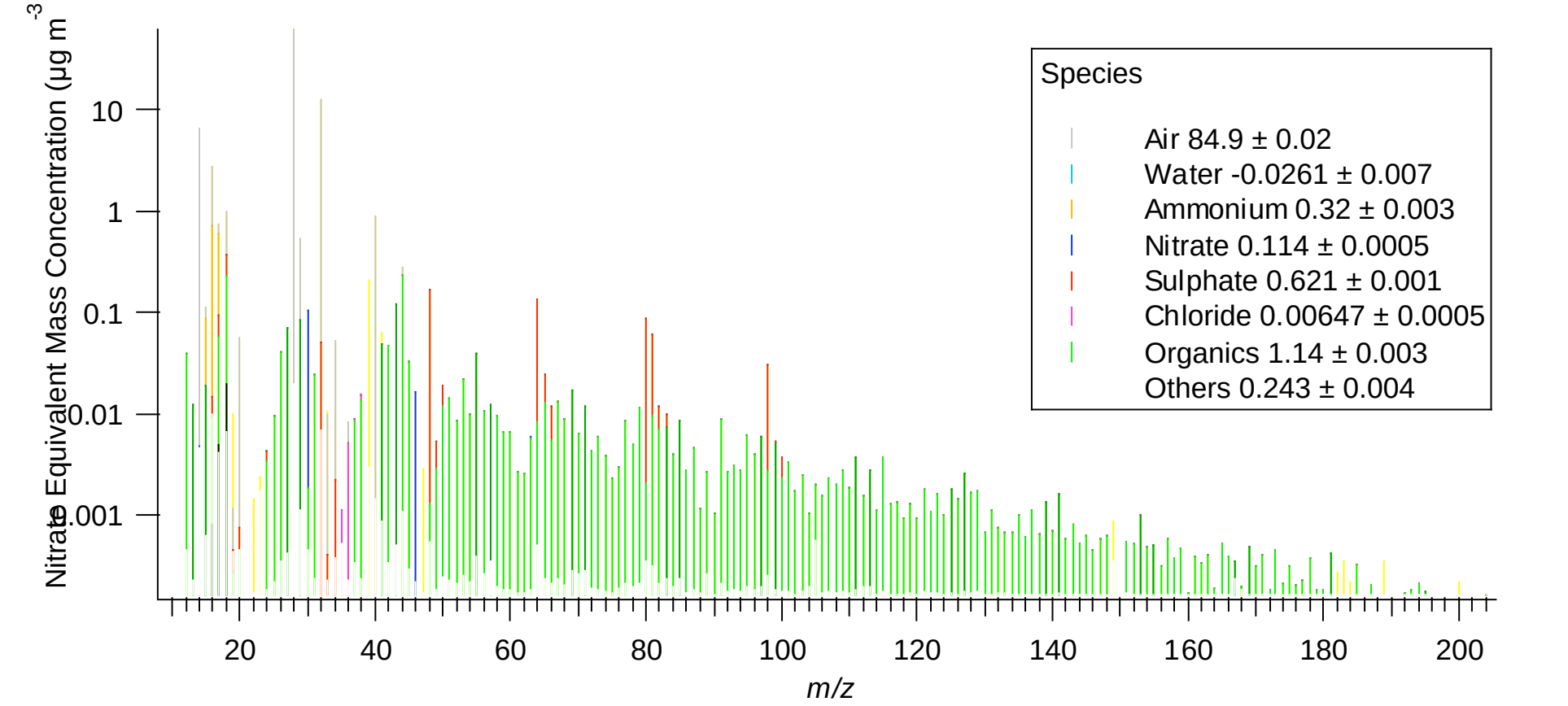
Particle acidity



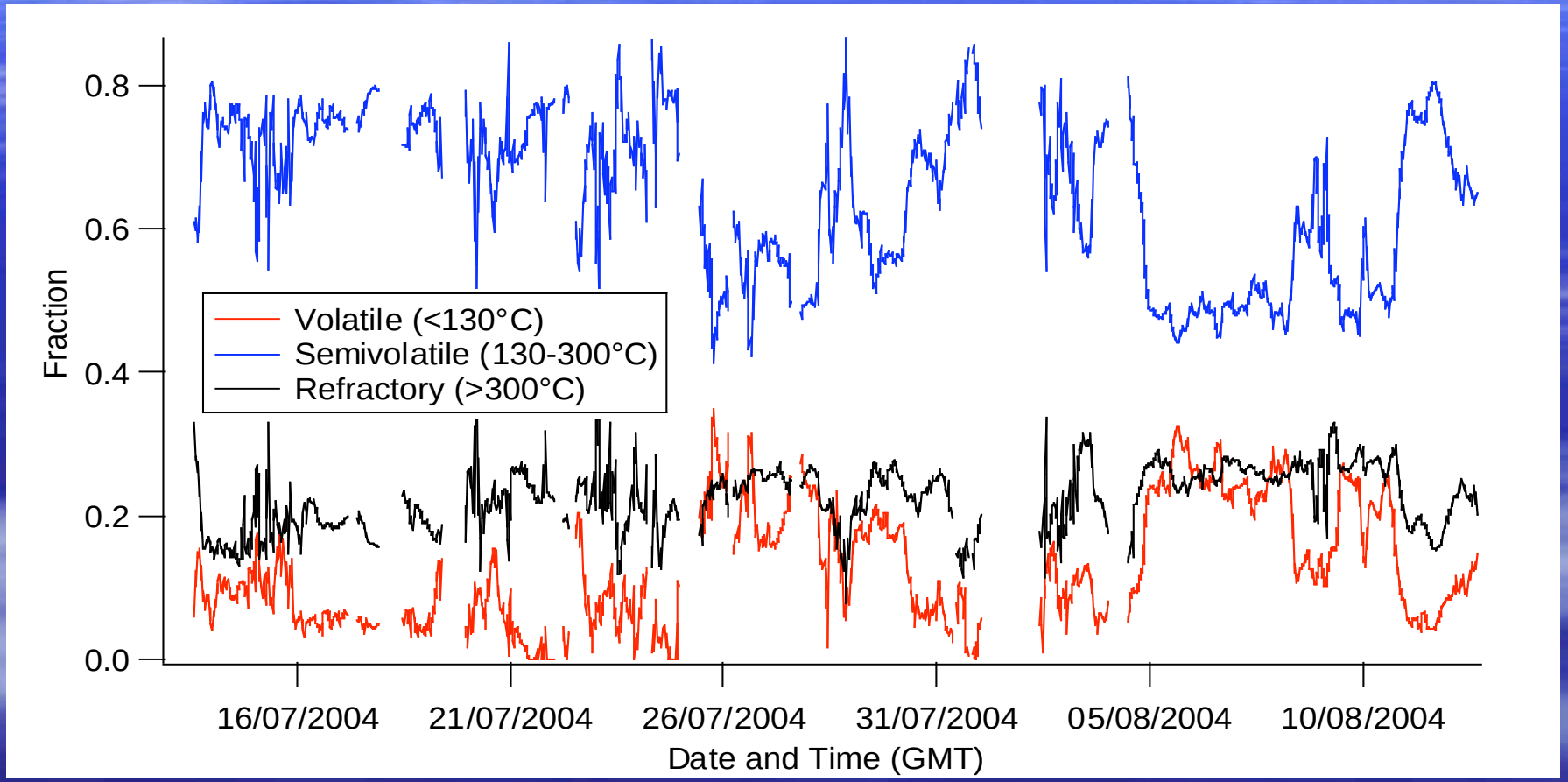
Nitrates



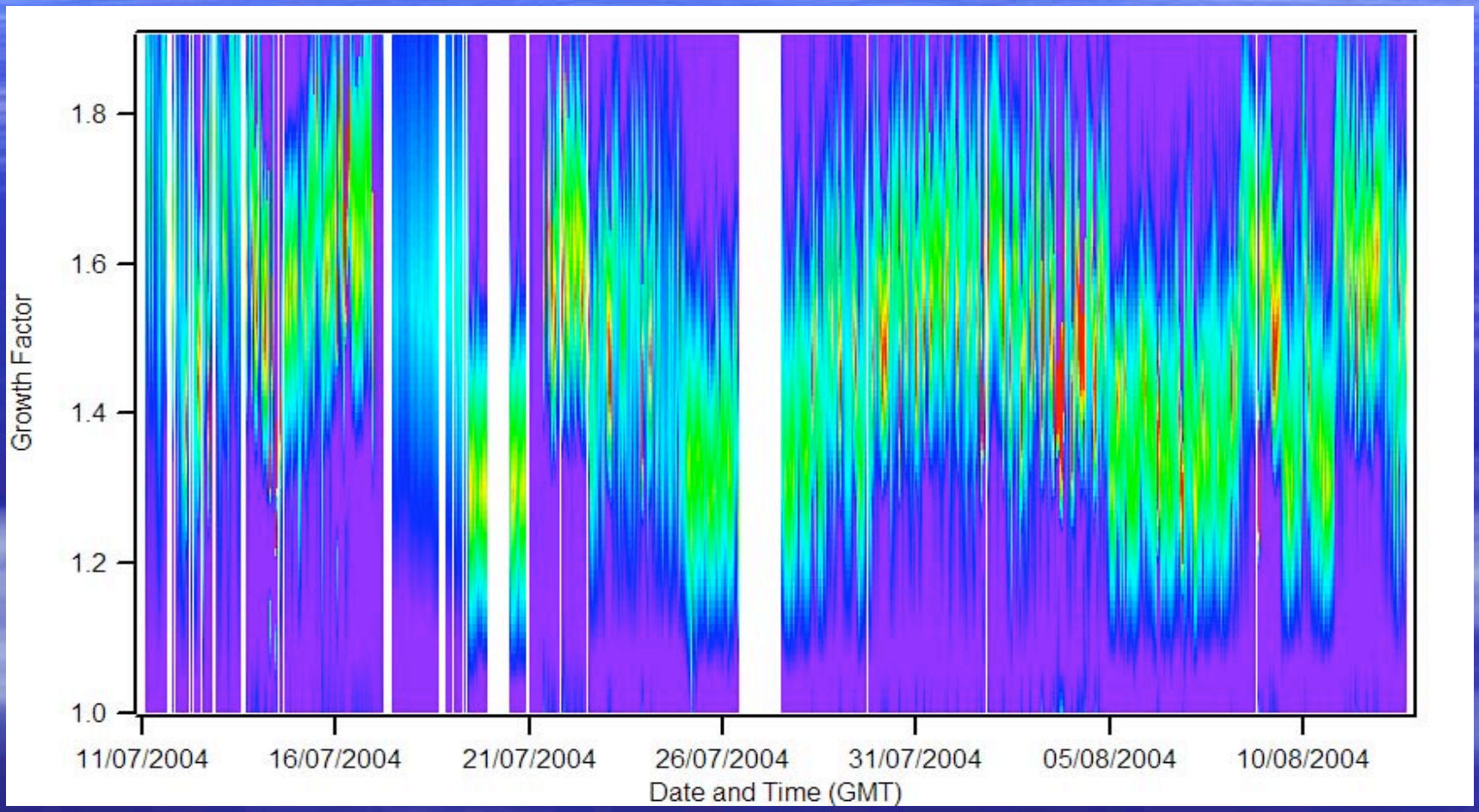
Mass Spectrum



Volatility


Fraction
0.8
0.6
0.4
0.2
0.0
Volatile (<130°C)
Semivolatile (130-300°C)
Refractory (>300°C)
16/07/2004
21/07/2004
26/07/2004
31/07/2004
05/08/2004
10/08/2004
Date and Time (GMT)

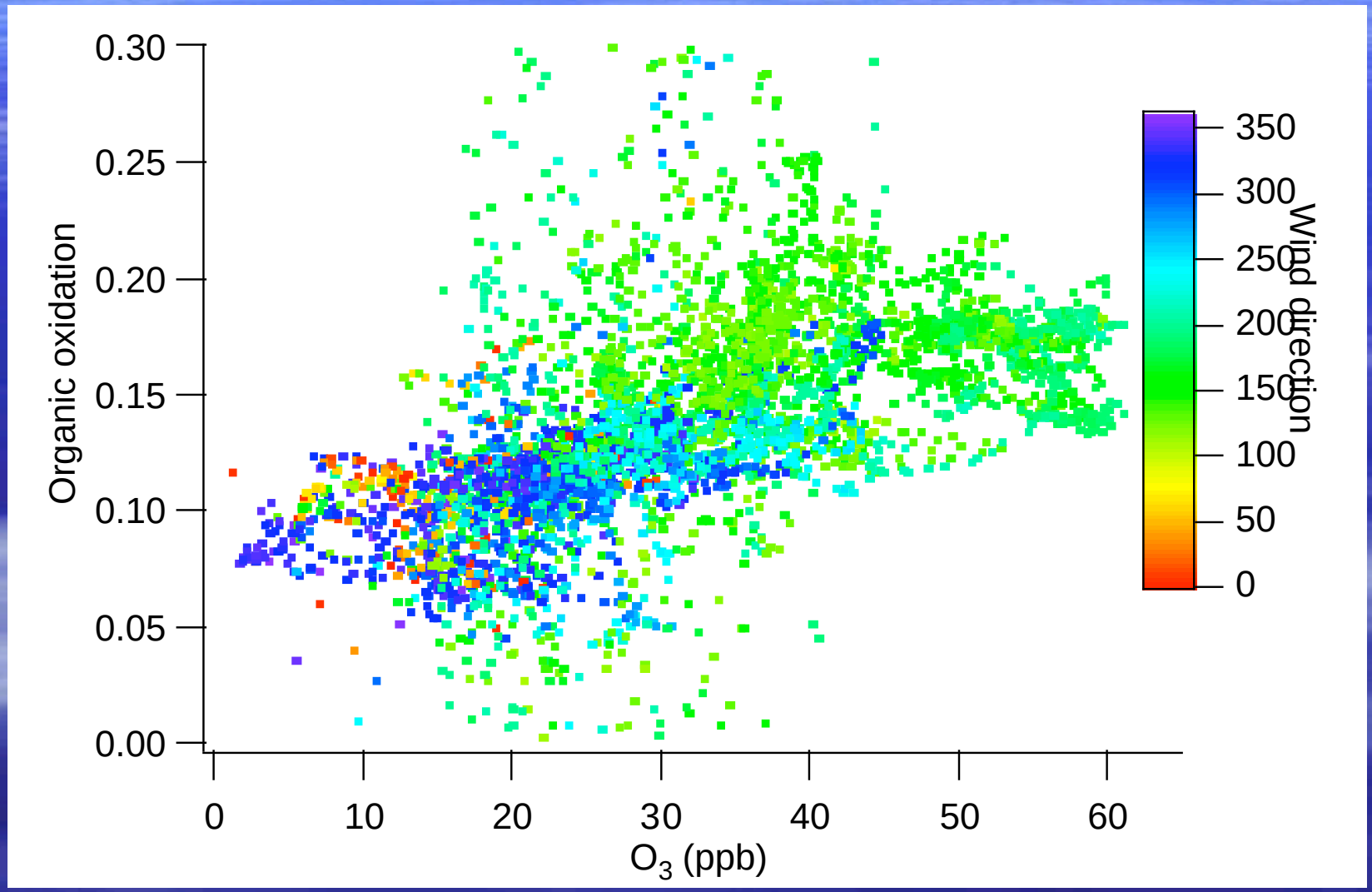
Hygroscopicity



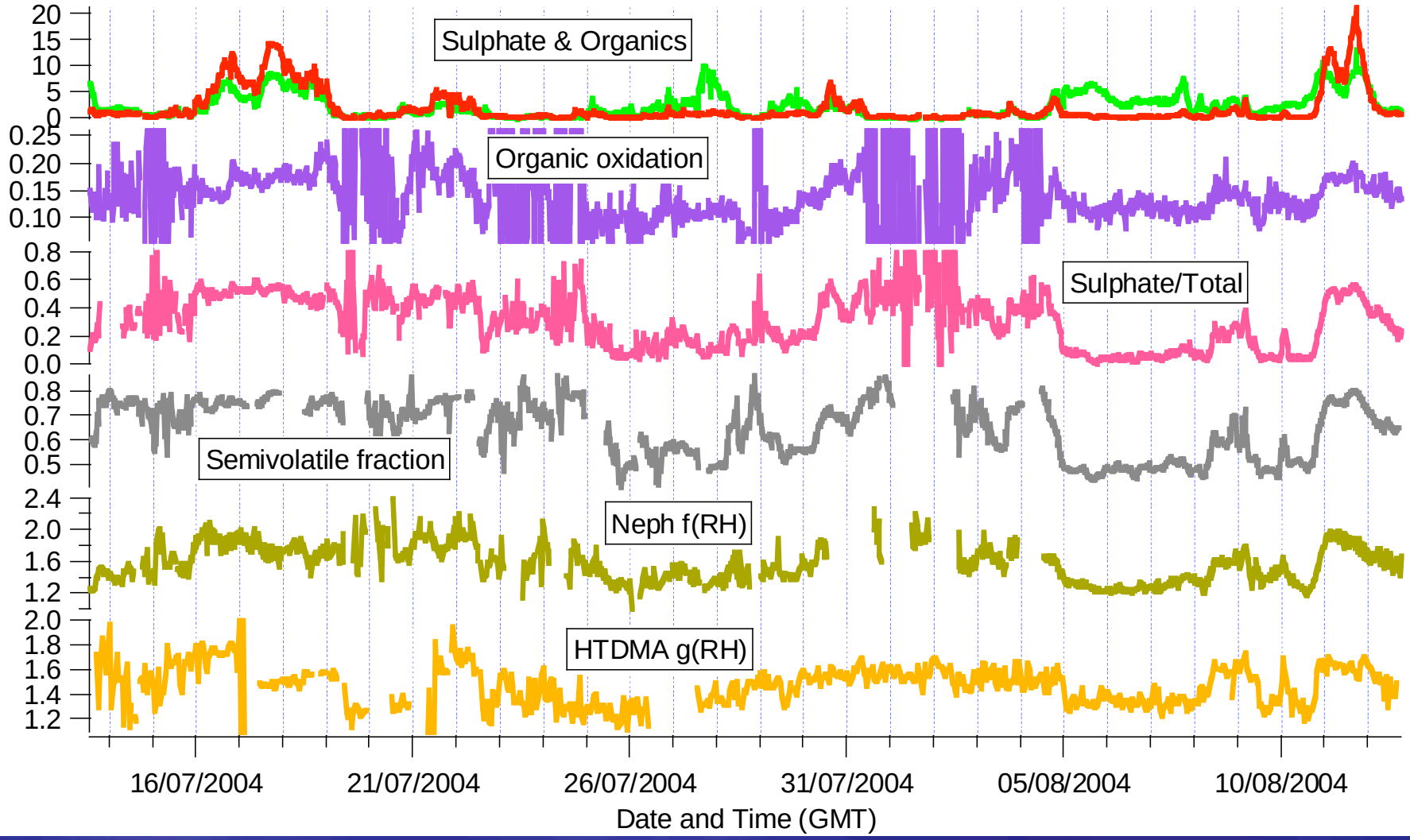
Two Types of Conditions

- Stop me if you've heard this one…
- Type A:
  - Particles mainly sulphate & organics
  - Low SO_2
  - Often from the eastern seaboard
  - Typically accompanied by a shallow fog layer
- Type B:
  - Mainly organics, no sulphate
  - Often from north Canada
  - No fog

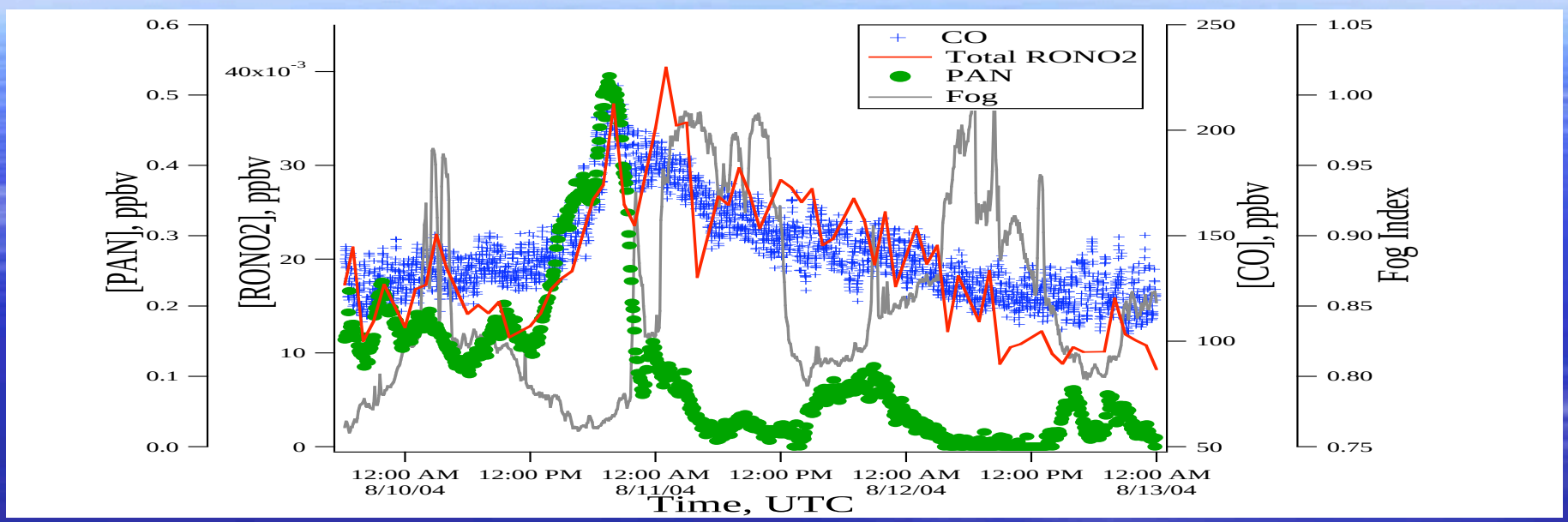
Link with ozone

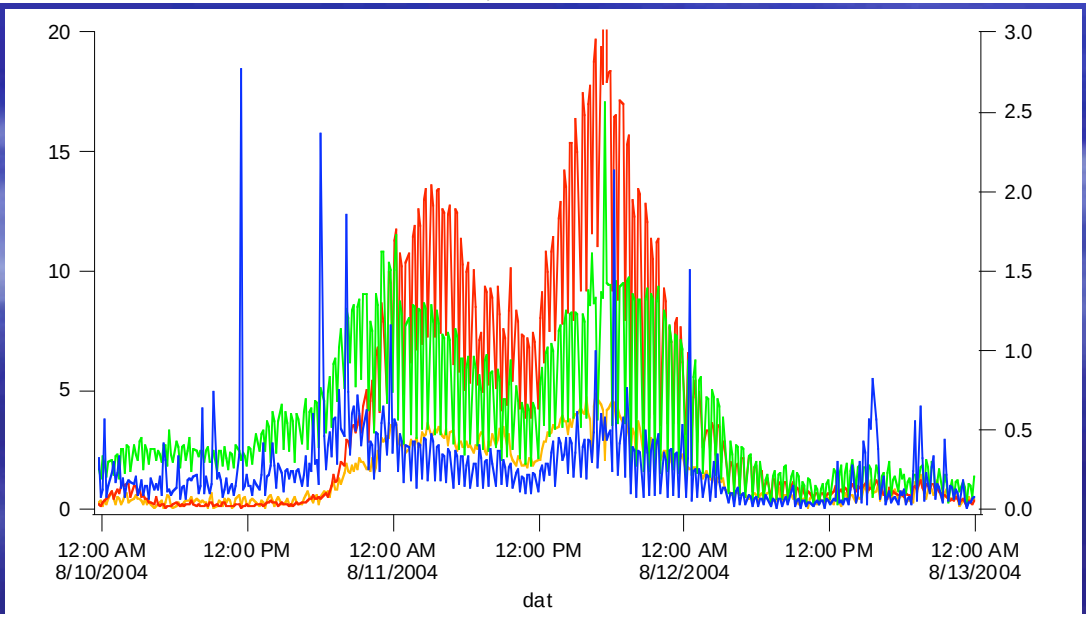


Bringing it together



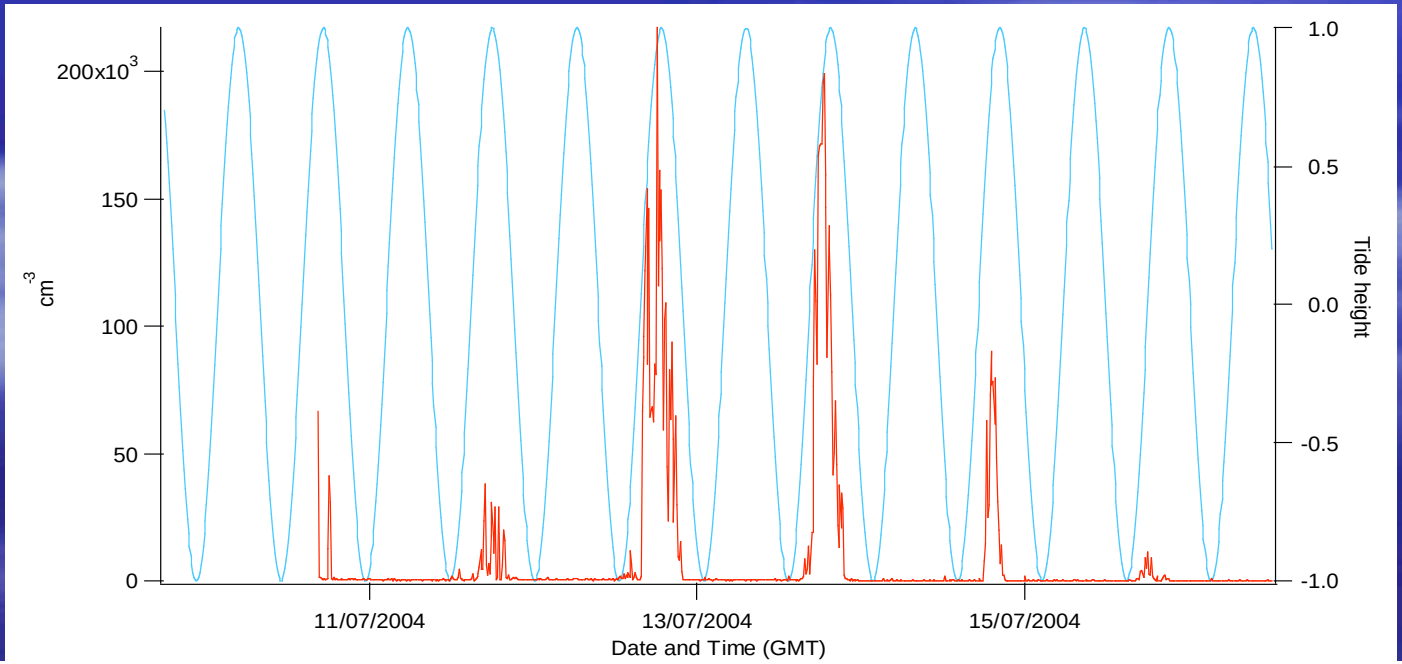
Transition?


CO
Total RONO2
PAN
Fog
[PAN], ppbv
[RONO2], ppbv
[CO], ppbv
Fog Index
40x10^-3
12:00 AM 8/10/04
12:00 PM
12:00 AM 8/11/04
12:00 PM
12:00 AM 8/12/04
12:00 PM
12:00 AM 8/13/04
Time, UTC


12:00 AM 8/10/2004
12:00 PM
12:00 AM 8/11/2004
12:00 PM
12:00 AM 8/12/2004
12:00 PM
12:00 AM 8/13/2004
dat

Nucleation?

- Occurred in discrete bursts, always during daytime
- Would be able to draw comparisons with Mace Head…
- …if it wasn't for the fact they occur at HIGH tide



Modelling work

- Colorado:
  - Number/mass closure
  - CCN closure
  - Scattering closure
  - Hygroscopicity?
- Manchester
  - Hygroscopicity
  - Activation properties

Contacts:

- PI: Doug Worsnop (ARI)
- Other bosses: Jose Jimenez (Colorado), Hugh Coe (Manchester)
- AMS/DMPS: James Allan (Manchester)
- Light scattering: Eben Cross (ARI/BC)
- Thermal Denuder: Alex Huffman (Colorado)
- HTDMA: Mike ‘turncoat’ Cubison (Manchester/Colorado)
- VTDMA: Guy Coulson (Essex)
- Number/CCN modelling: Peter DeCarlo (Colorado)
- Hygroscopicity Modelling: David Topping (Manchester)
- Further organic analysis: Qi Zhang (Colorado)

- Thanks to Betsy Andrews & co. for the neph data and Allen Goldstein for the ozone & met data. Also to Brent Williams and Dylan Millet for the helpful discussions.