Visualization of Particulate Air Pollution Data with AVS/Express

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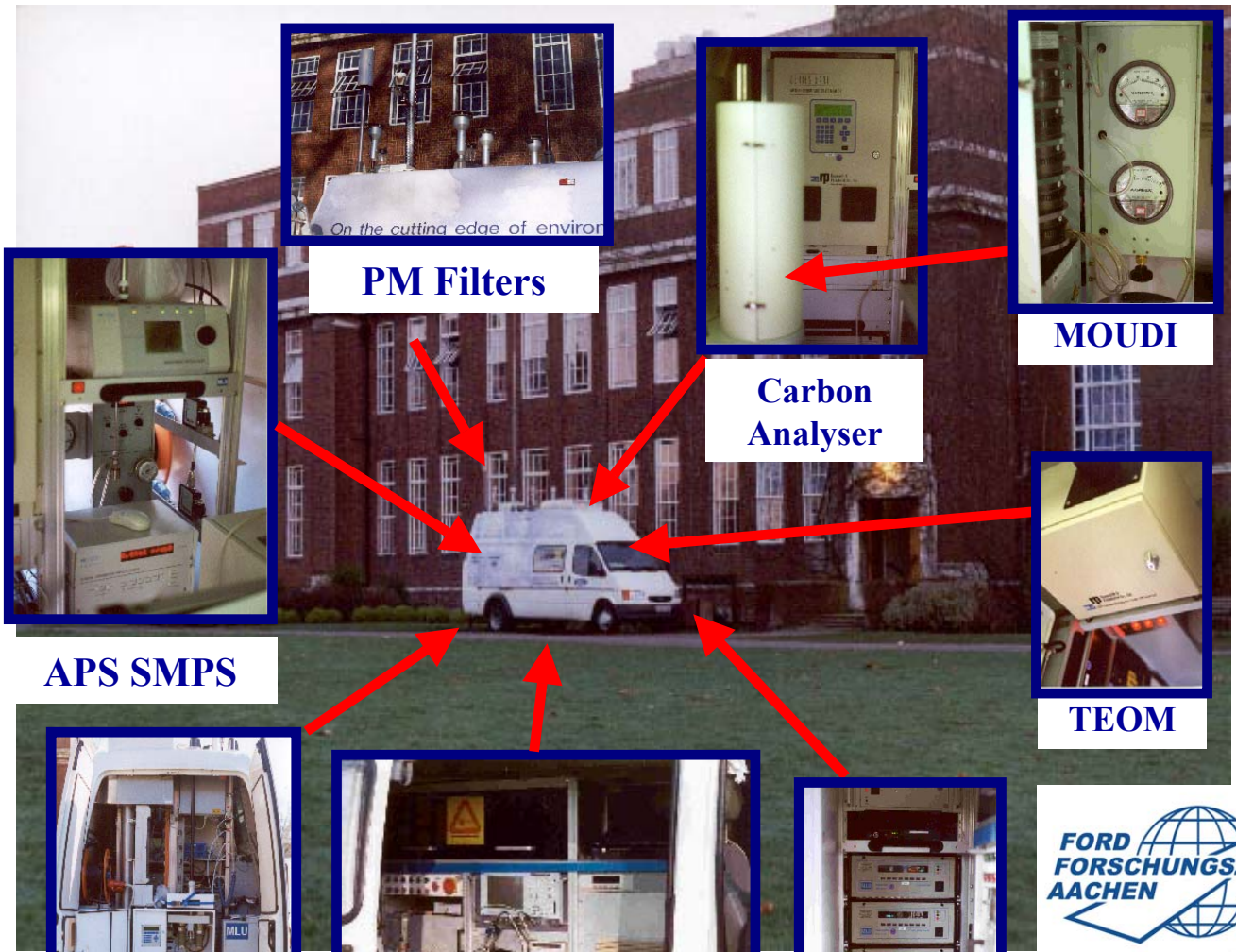
Background

- Study of atmospheric chemistry and atmospheric particles
- Field campaigns – London, Feb, July 2001
- Measure a wide range of properties of particles and gases
- Diverse datasets

The Ford Aerosol Research Van

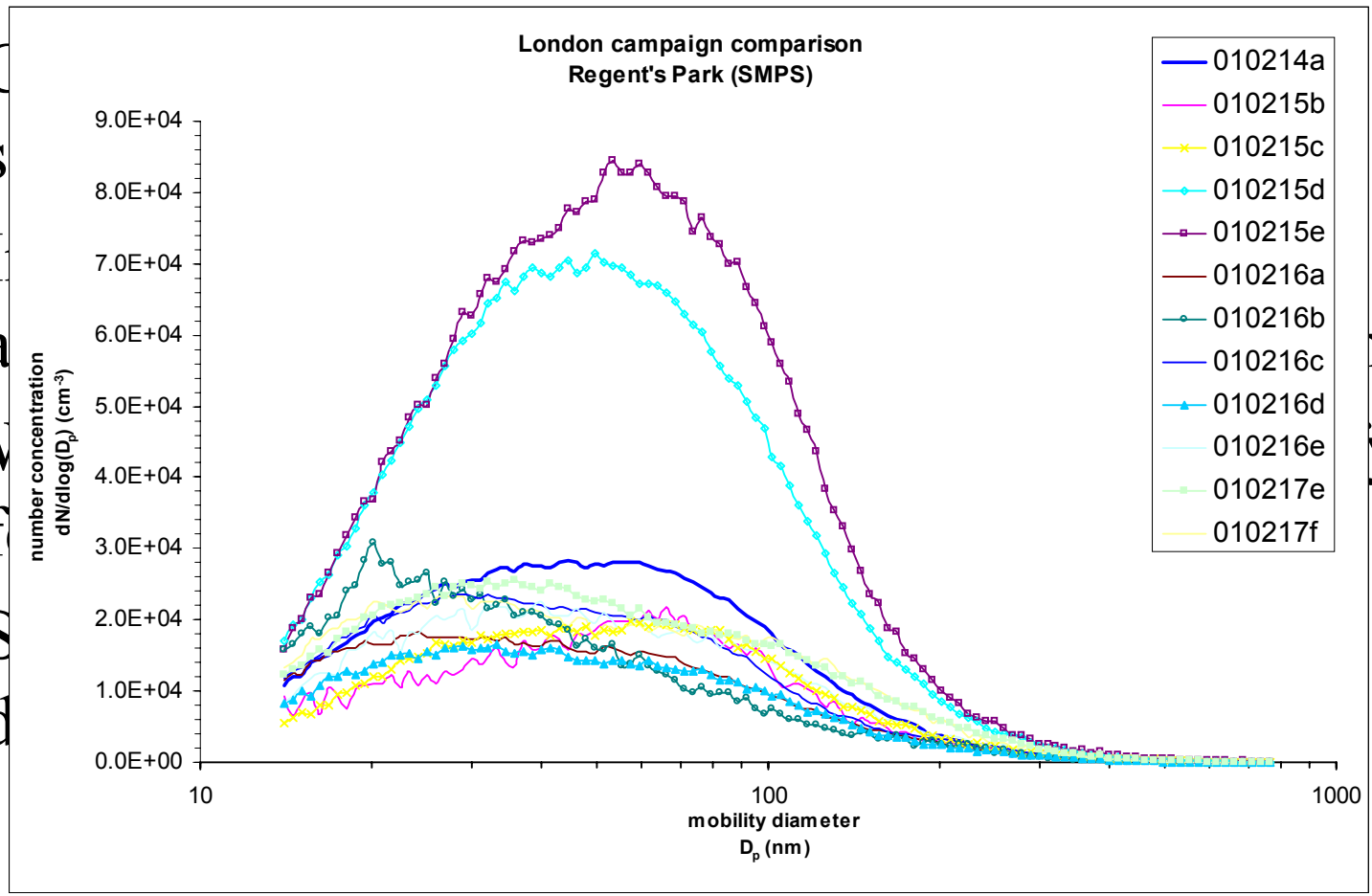


Instruments and data

- Particle size instruments
  - Measure number of particles within a range of size bins
  - Constant size bins, logarithmically spaced
  - Regular sampling times for each instrument, differ between instruments
- Single particle mass spectrometer
  - Detects a single particle
  - Measures abundance of individual atoms/molecular fragments
  - Provides information on chemical composition of particles
  - High mass resolution => large amount of data
  - Sampling rates vary greatly

Traditional Analysis

- 2D graphs in Excel, average spectra and individual times
- C
  s
- I
  a
- V
  f
- S
  d



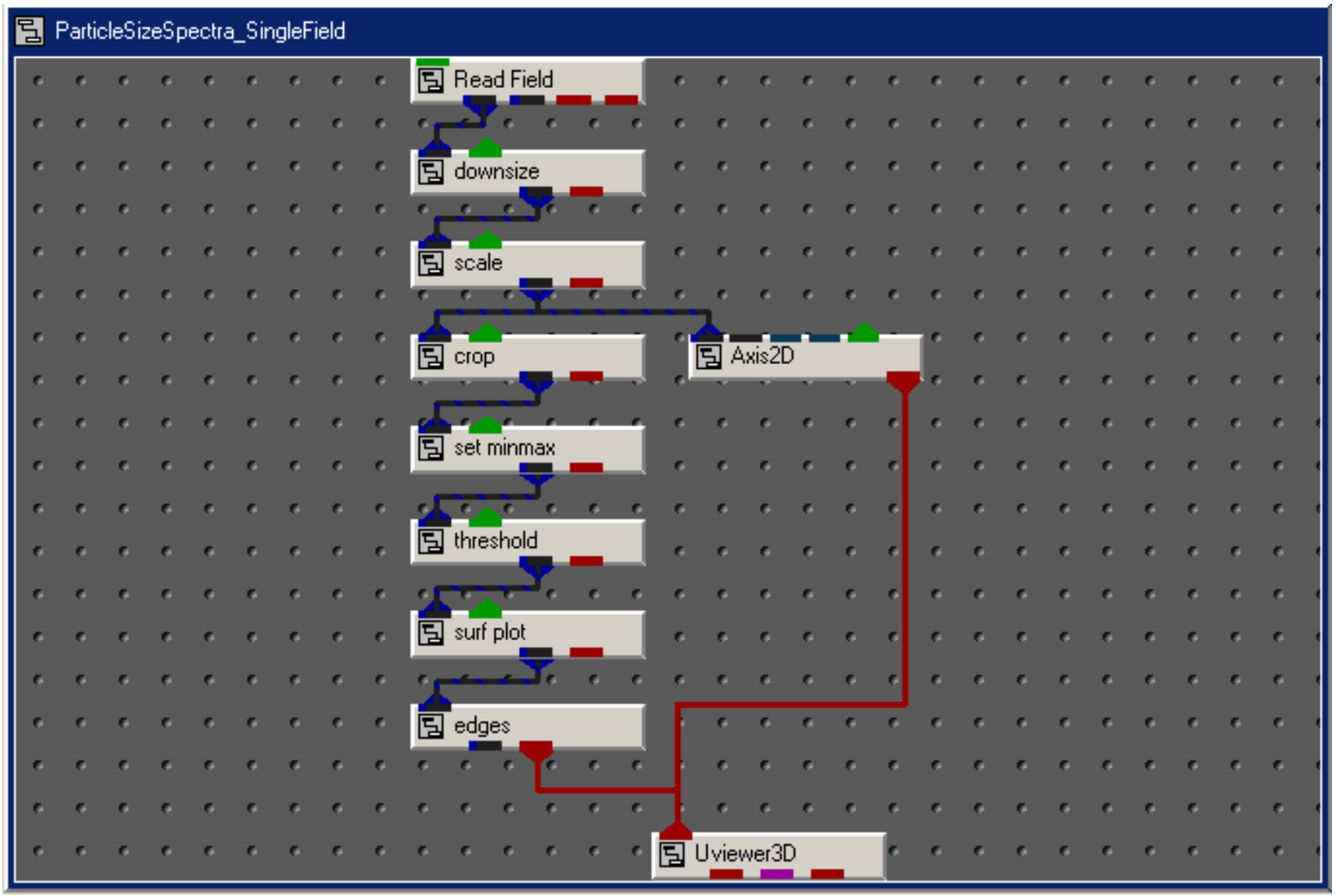
Obstacles

- Experimental data vs. model data
- Discontinuous data
  - Separate sites
  - Instrument sampling periods and problems
- Different time resolution between instruments
- Amount of data
  - Mass spectra ~30,000 data points per measurement, irregular mass axis, >1000 measurements

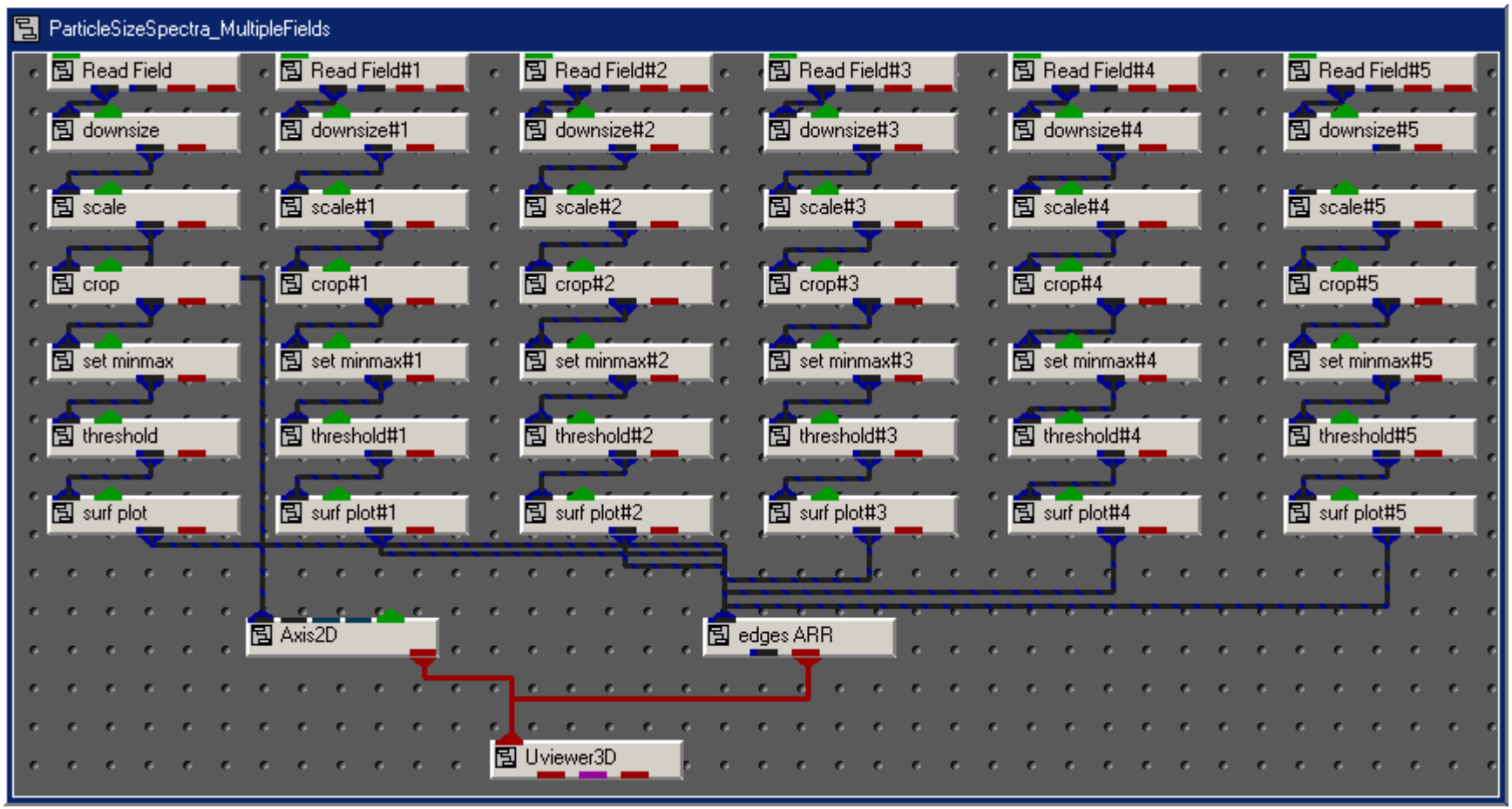
Approach

- Pre-process data
  - Particle size data:
    - cut and paste to produce files to be read as fields.
    - individual fields for separate measuring periods
  - Mass spectra data:
    - write custom C code to filter data to remove noise
    - bin data into integer mass units
    - associate time with each set of data
- Use field based Express networks
  - Continuous mappers for particle size data
  - Discontinuous mappers for mass spectra data

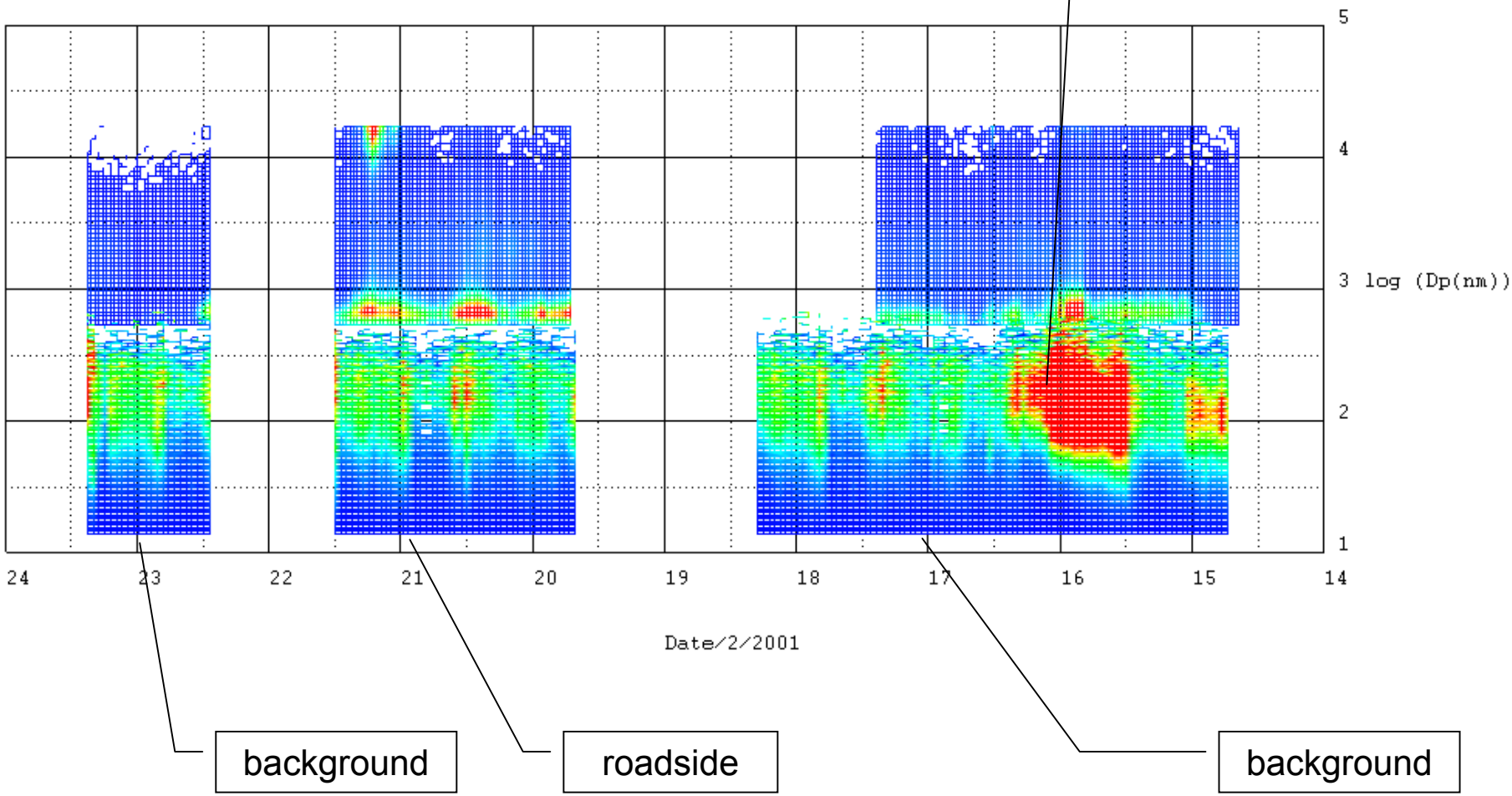
Particle size data

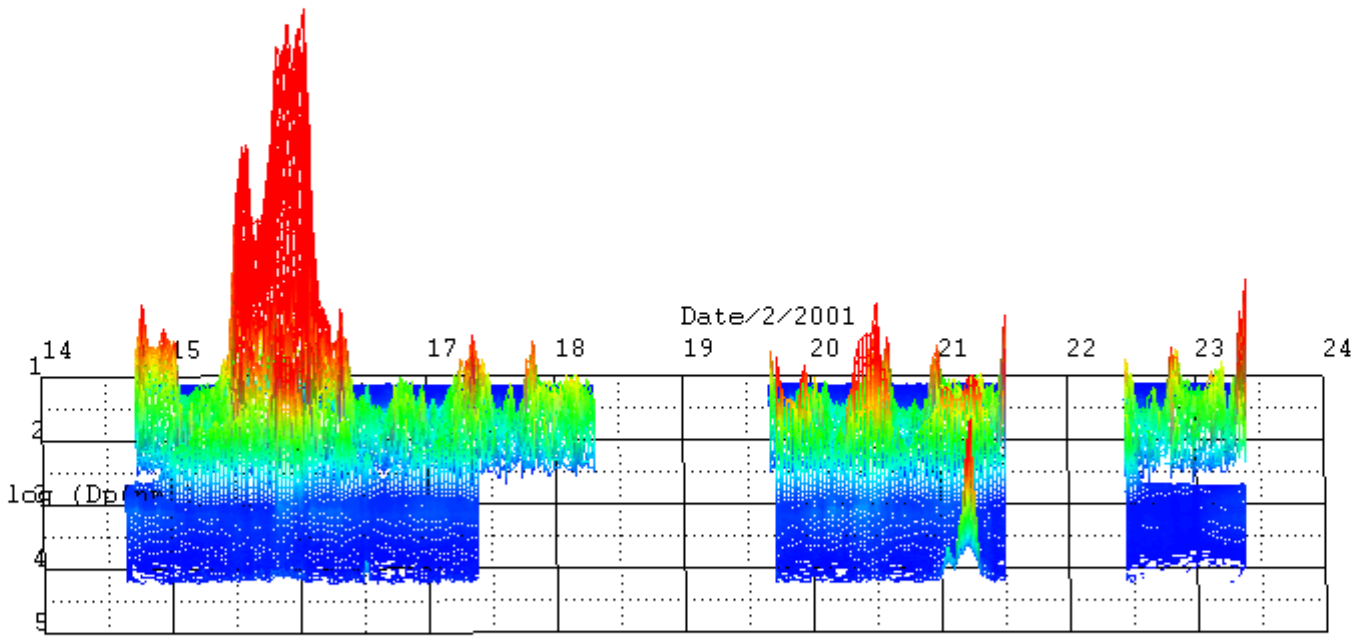


Particle size data - multiple fields

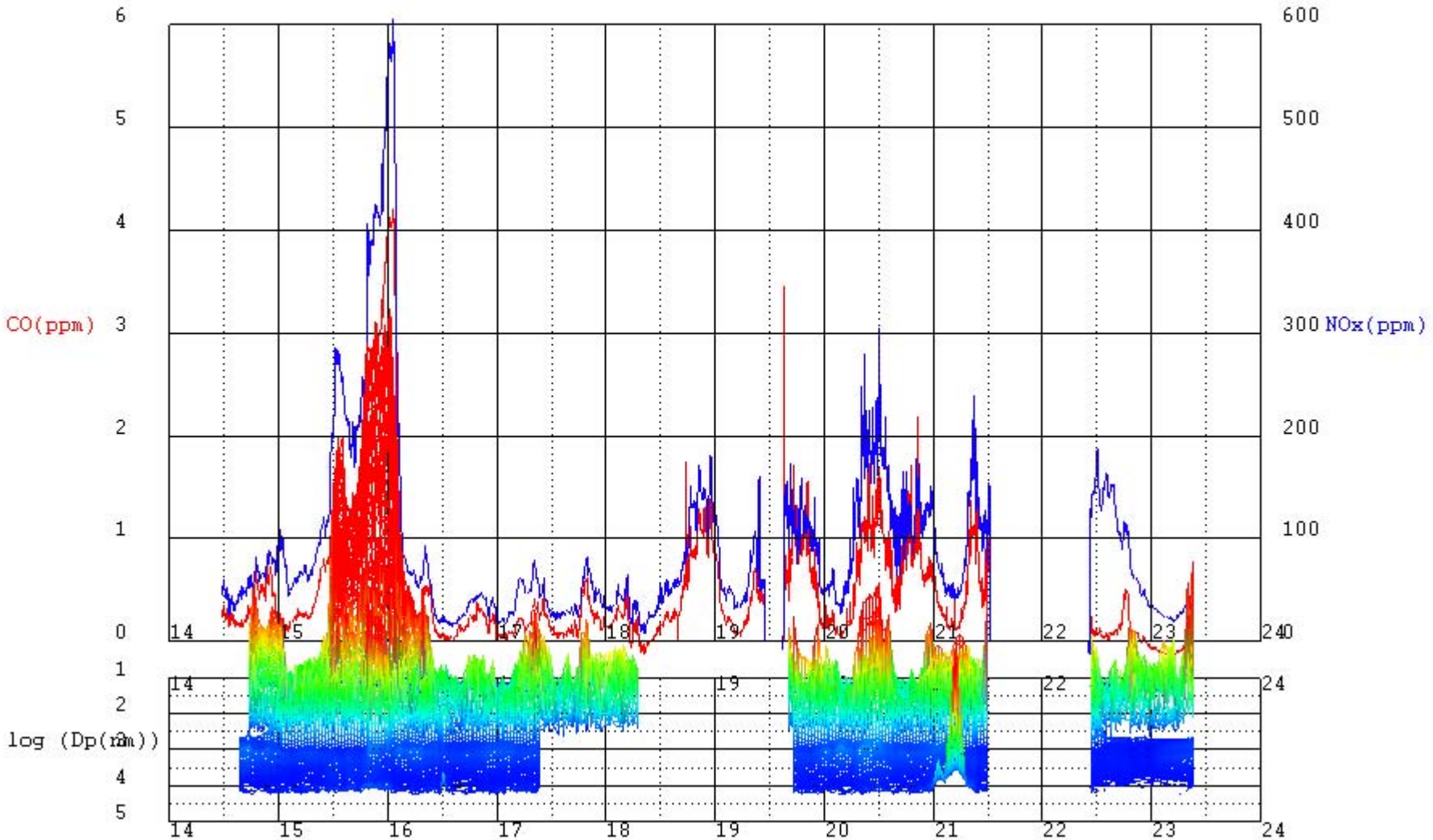


Particle surface area against time and diameter

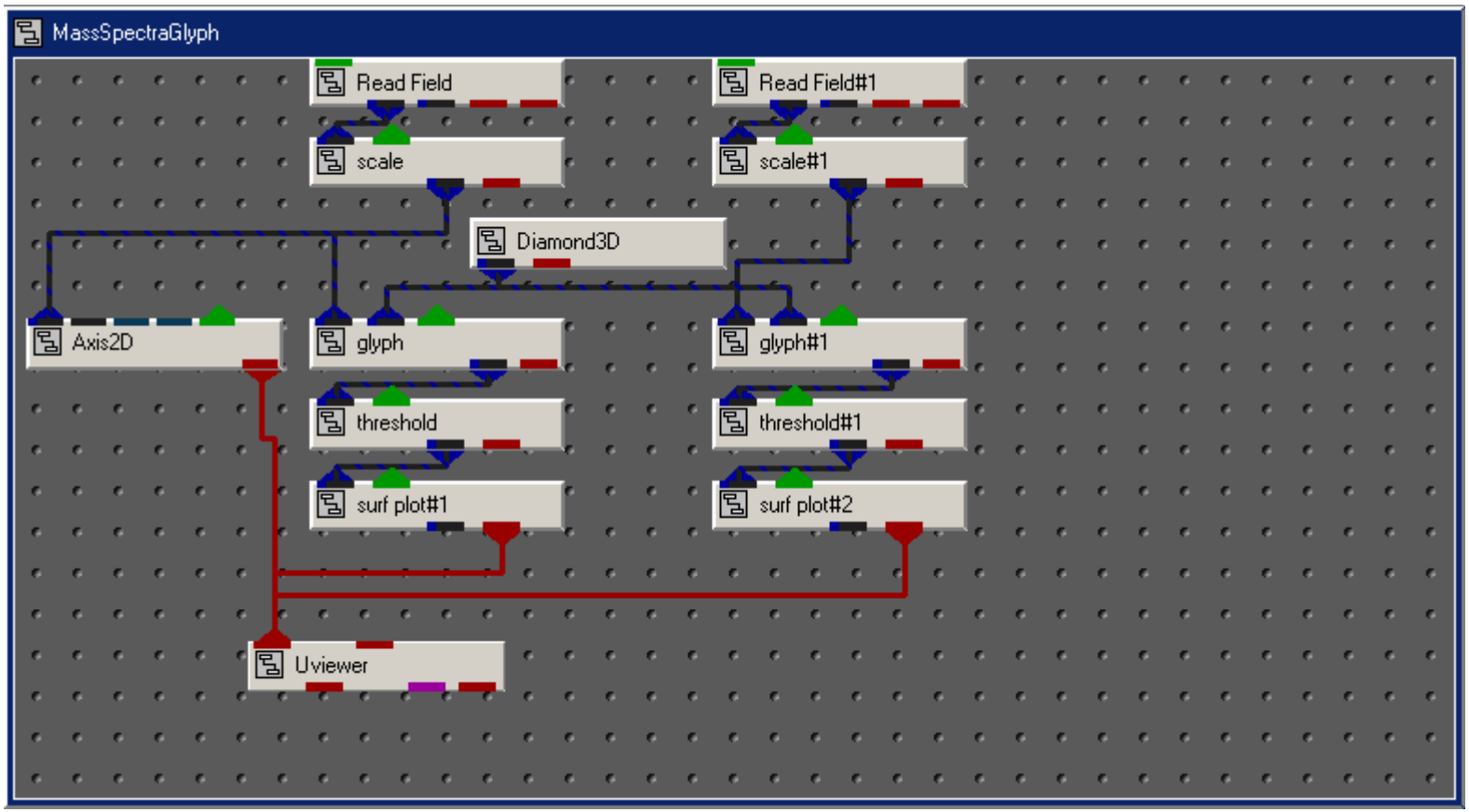



Date/2/2001
14
15
17
18
19
20
21
22
23
24
1
2
4
5

Particle size and gas data

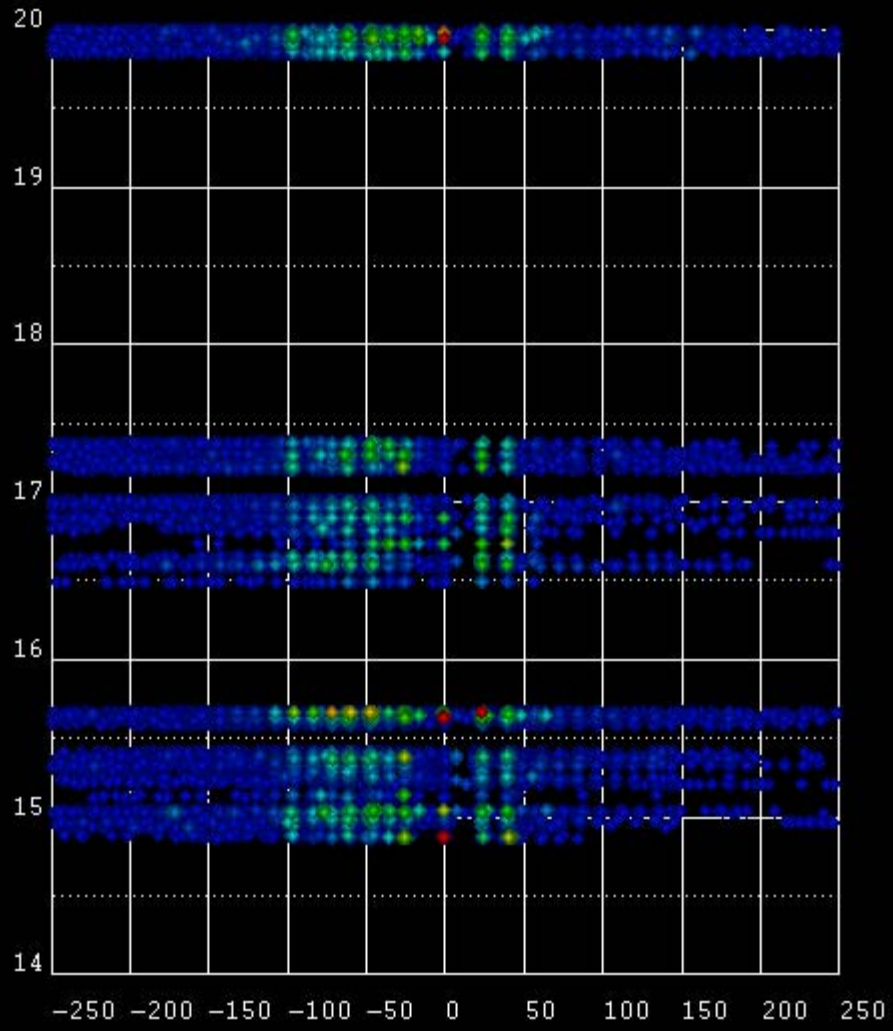


Mass spectra



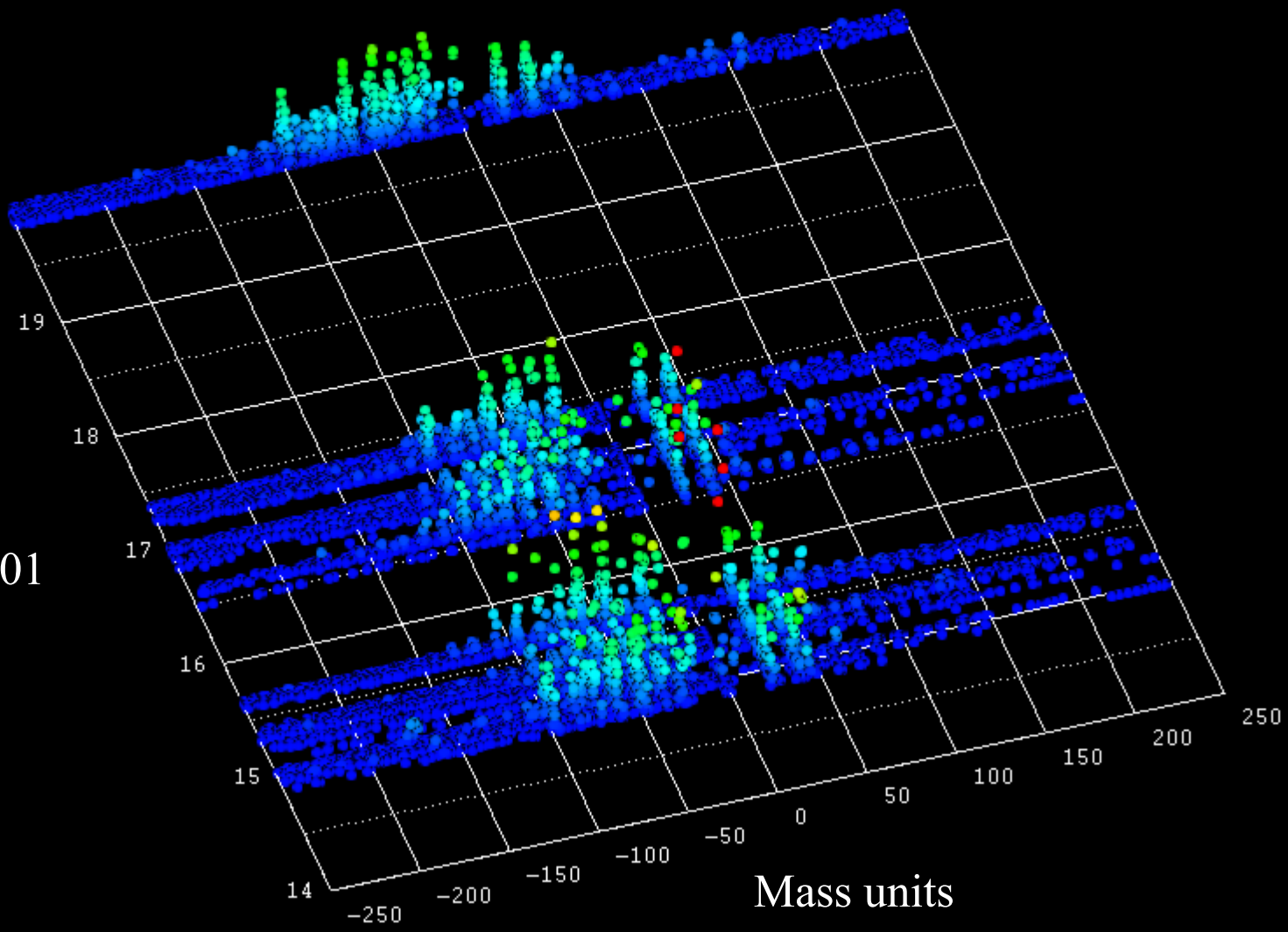
Glyph plot of mass spectra data

Date/2/2001



Mass units

3DPoint glyph



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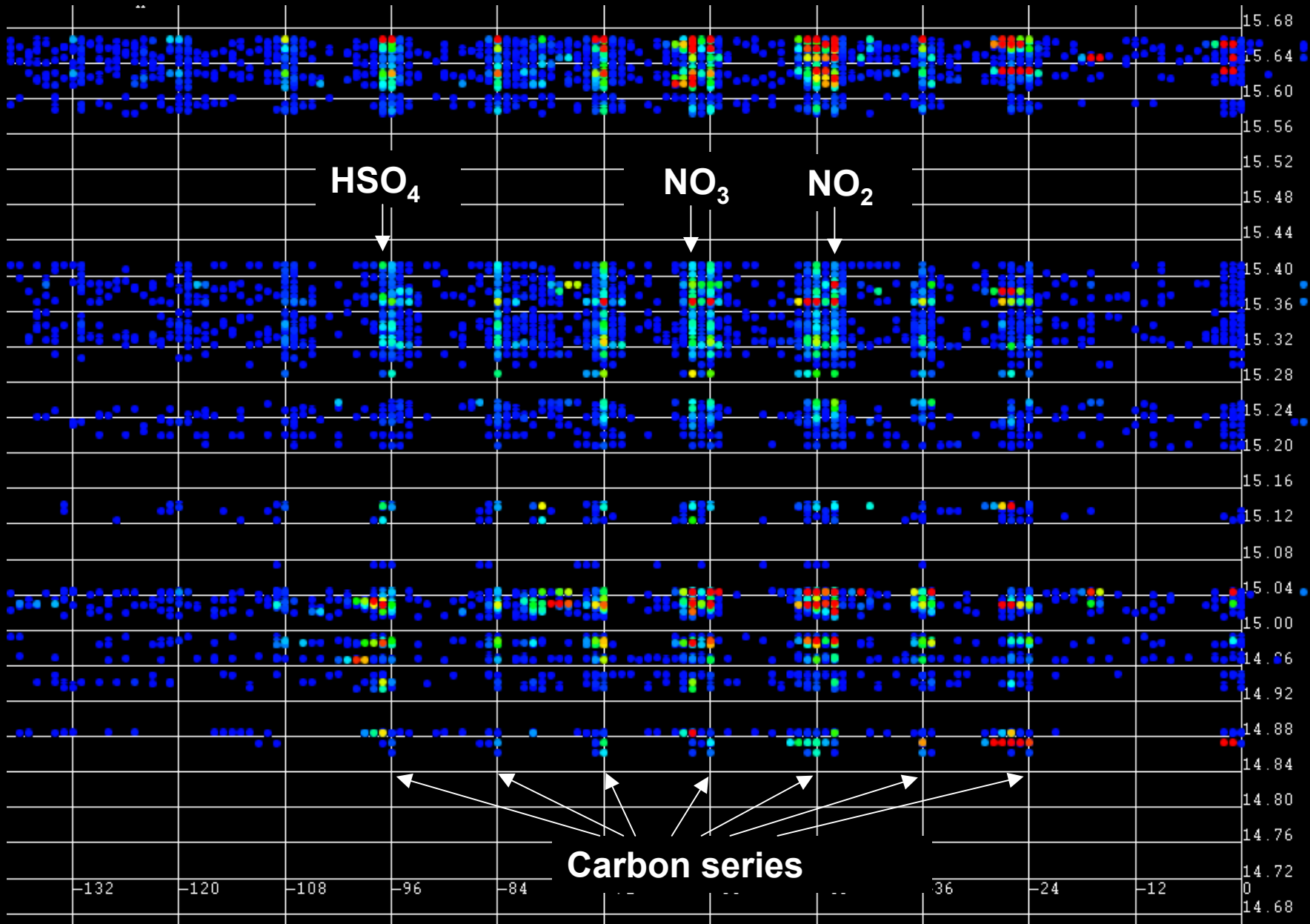
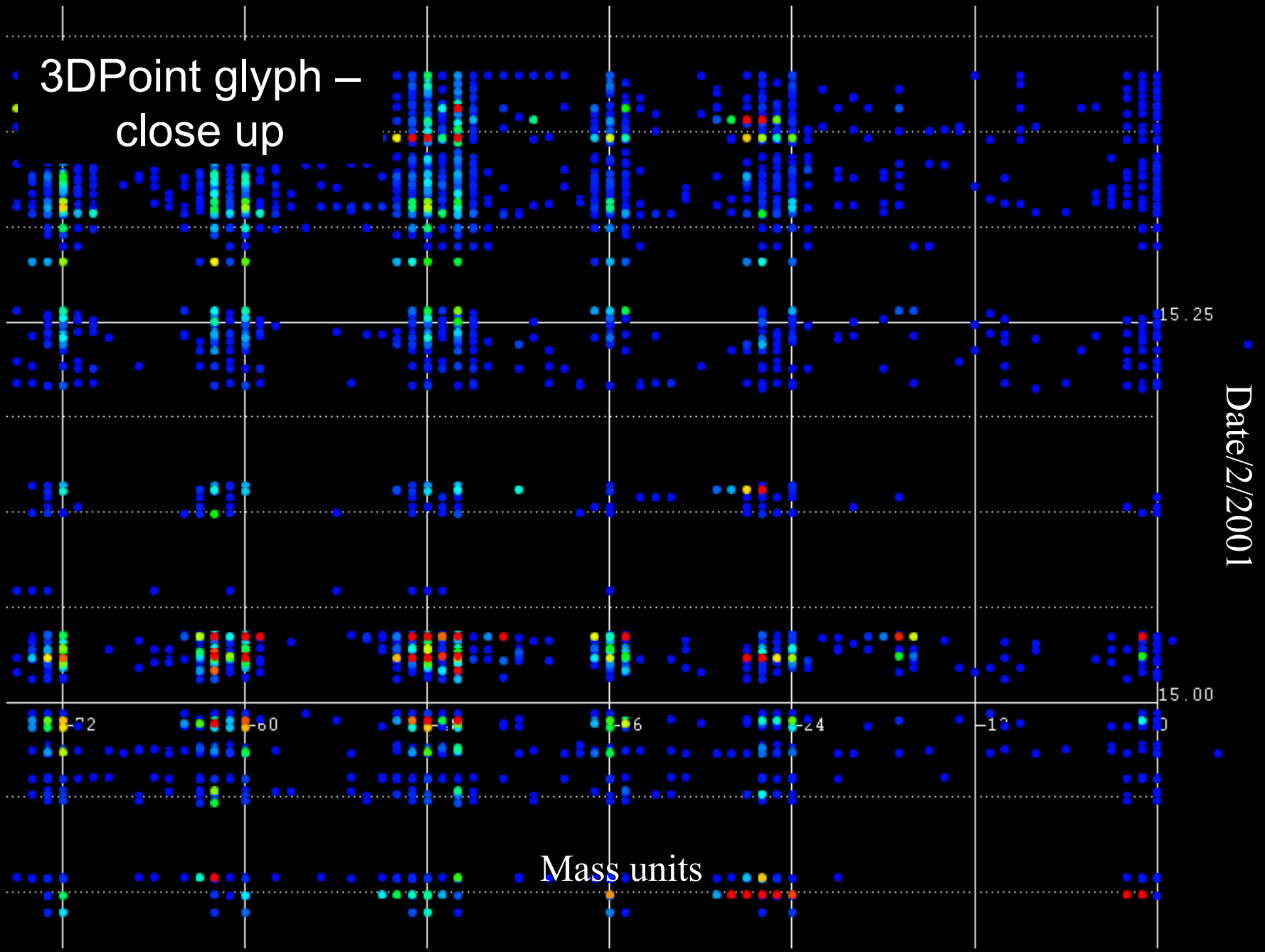
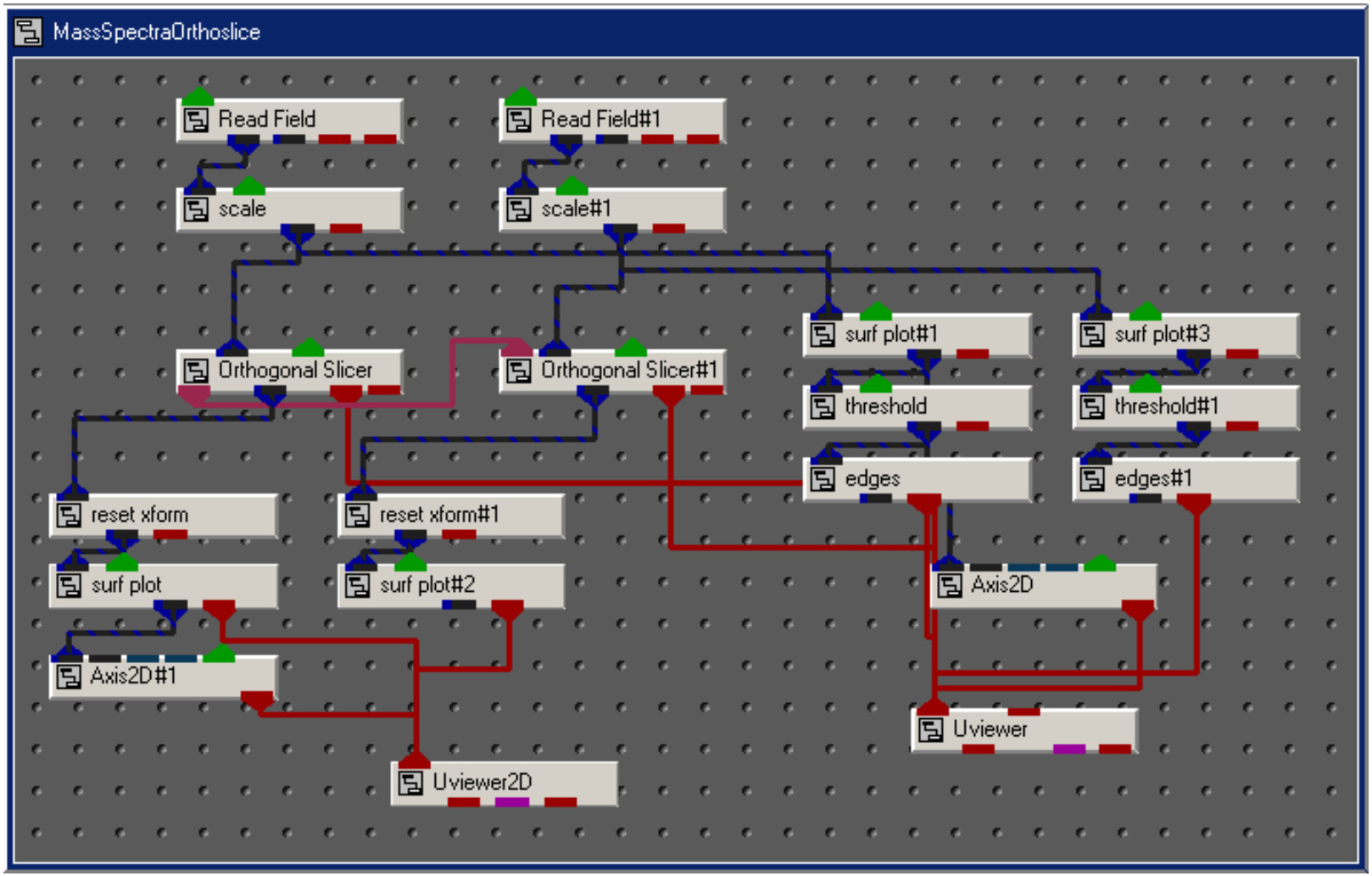
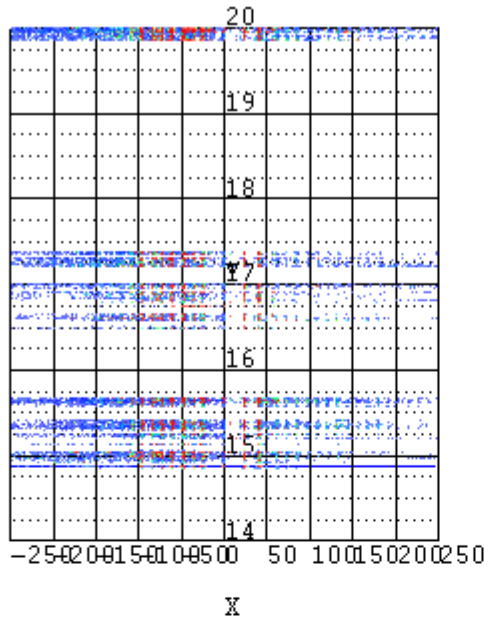

HSO4
NO3
NO2
Carbon series
Mass units
Date/2/2001
15.68
15.64
15.60
15.56
15.52
15.48
15.44
15.40
15.36
15.32
15.28
15.24
15.20
15.16
15.12
15.08
15.04
15.00
14.96
14.92
14.88
14.84
14.80
14.76
14.72
14.68
-132
-120
-108
-96
-84
-36
-24
-12
0


3DPoint glyph –
close up
15.25
15.00
Date/2/2001
Mass units

Individual mass spectrum

- Orthoslice fields to produce spectrum





File Editors

Modules Orthogonal_Slicer

bounds

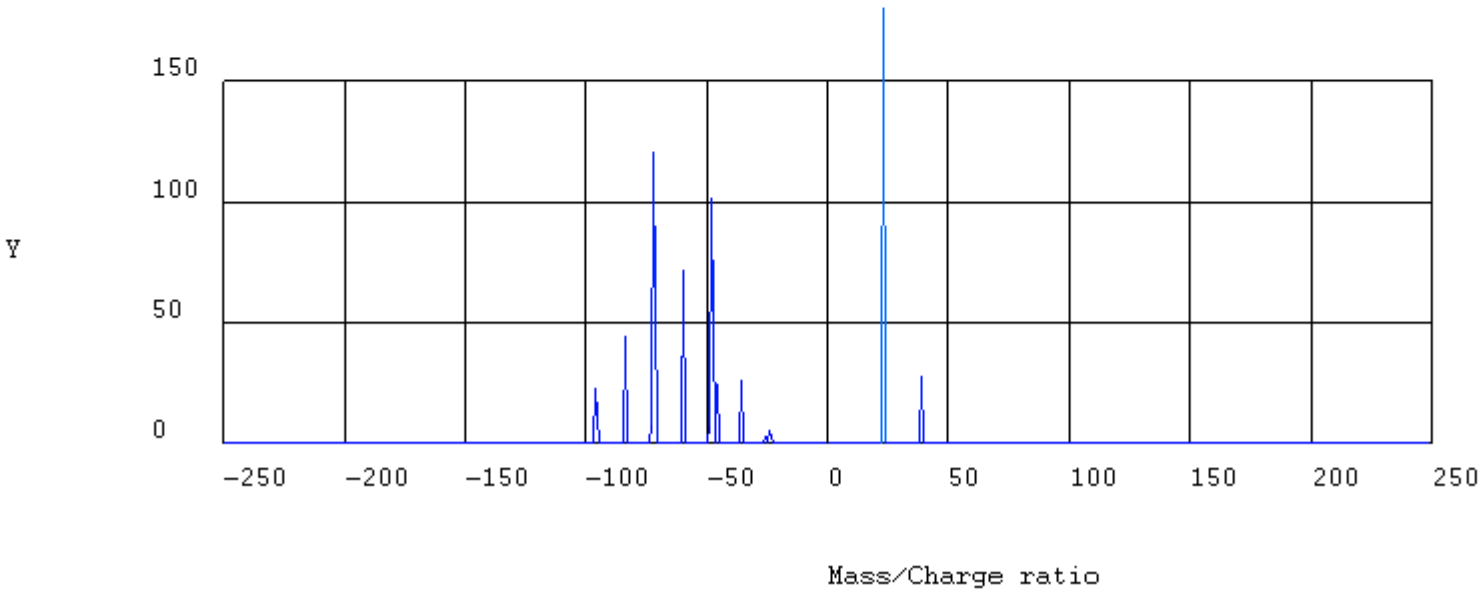
axis 1 1.00

plane 2 2.00

3D Top Select Object...

<idle>

Scene



Next steps

- Visualise particle size and gas data alongside mass spectra
- Display actual times rather than field plane index for slices
- Correlations between data sets?

Conclusions

- AVS/Express allowed us to:
  - visualise all of our data at one time
  - combine data from different instruments
  - extract time slices of data for examination
- but,
  - extensive pre-processing was necessary, and
  - it took a while

Functionality wish list

- Log scaling of field coordinates/axes
- Log scaling of values for datamap
- AxisARR module
- OrthosliceARR module that can deal with discontinuous fields

Acknowledgements

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