Universiteit Utrecht

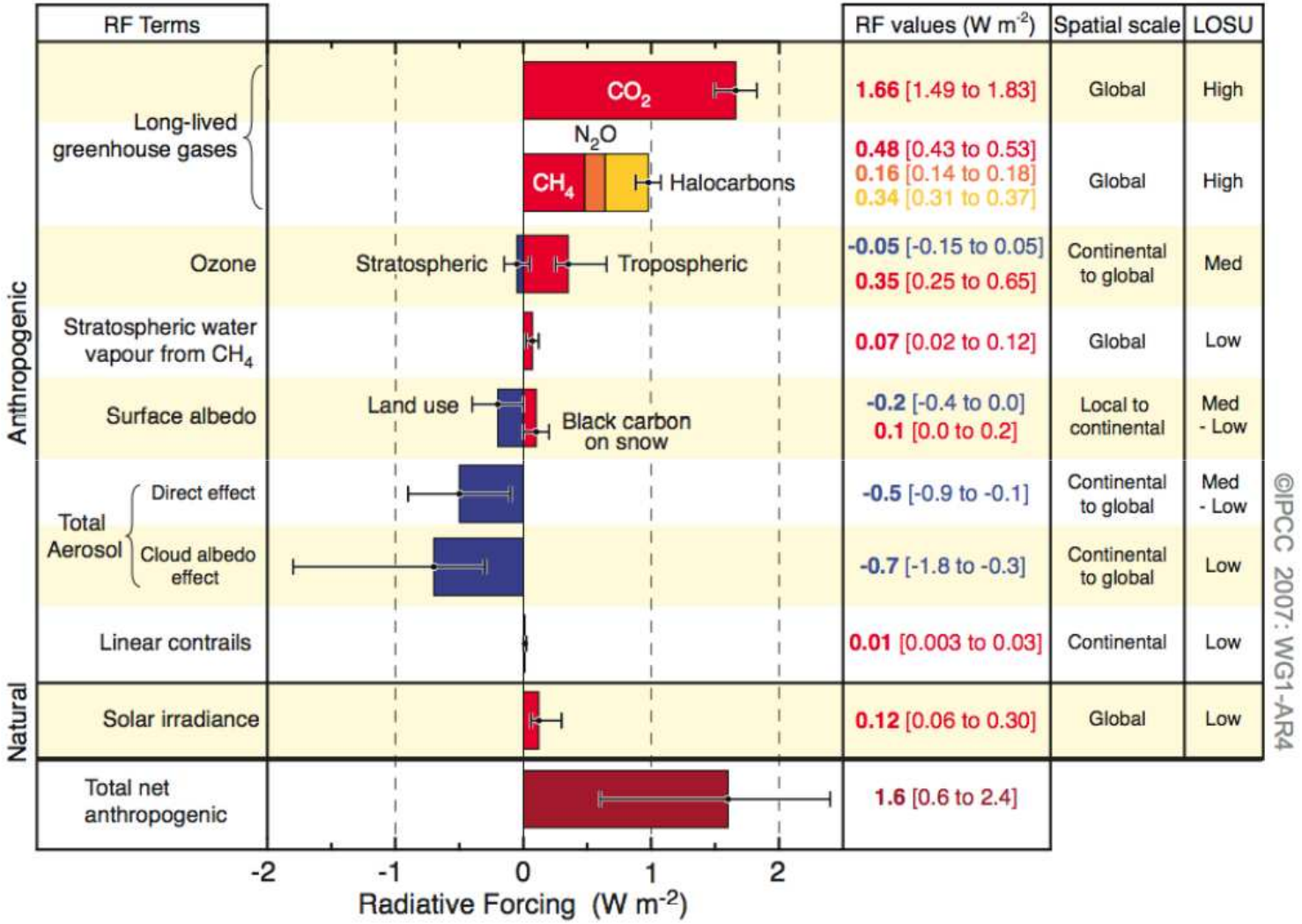
[Faculty of Science
Physics and Astronomy]

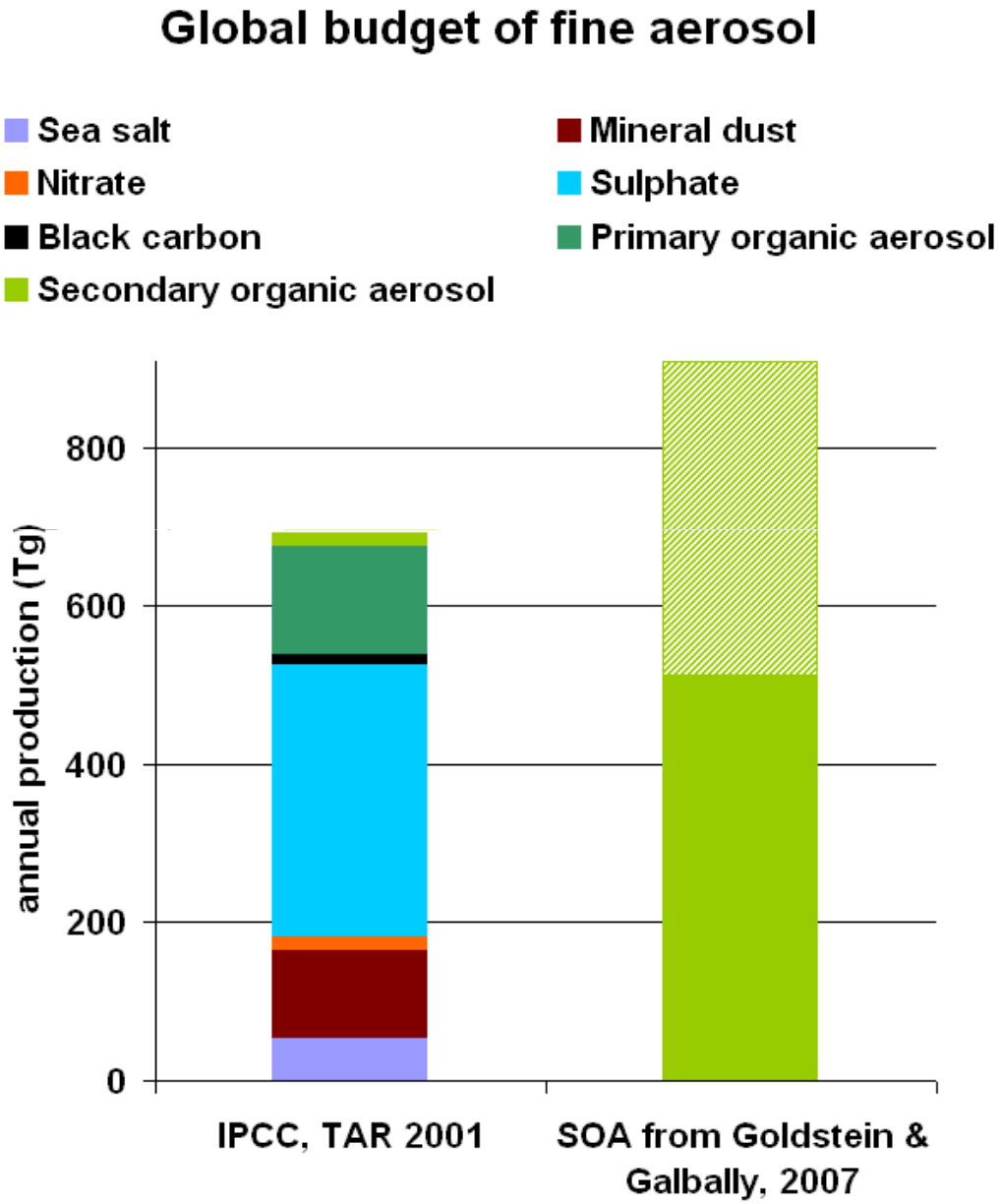
In-Situ Messung von organischen Verbindungen in Aerosolen und in der Luft am Hohen Sonnblick

Rupert Holzinger, Institute for marine and atmospheric research (IMAU), Utrecht University.

IMAU
Institute for Marine and Atmospheric research Utrecht

Radiative Forcing Components



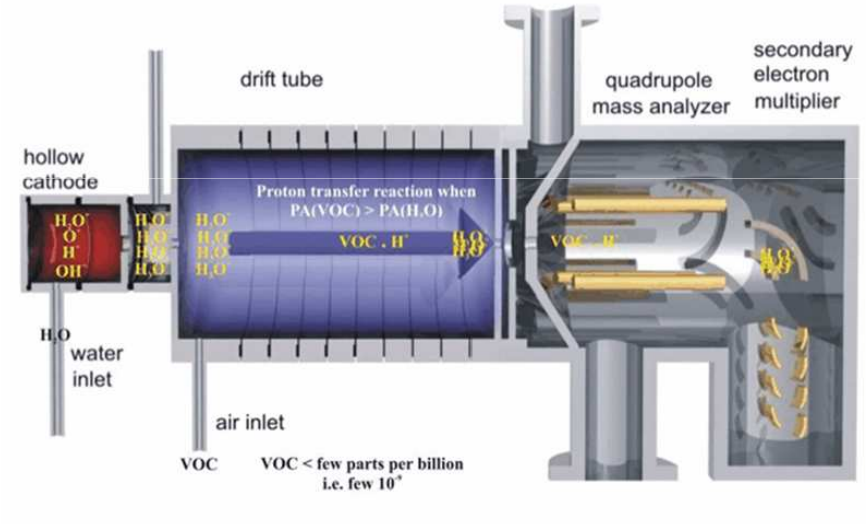


IPCC, TAR:
POA: 138 Tg/yr
SOA: 17 Tg/yr

Kanakidou et al. 2005:
SOA: 36 Tg/yr

Goldstein and Galbally, 2007:
SOA: 510-910 Tg/yr

The basis: Proton-Transfer-Reaction Mass-Spectrometry (PTR-MS)



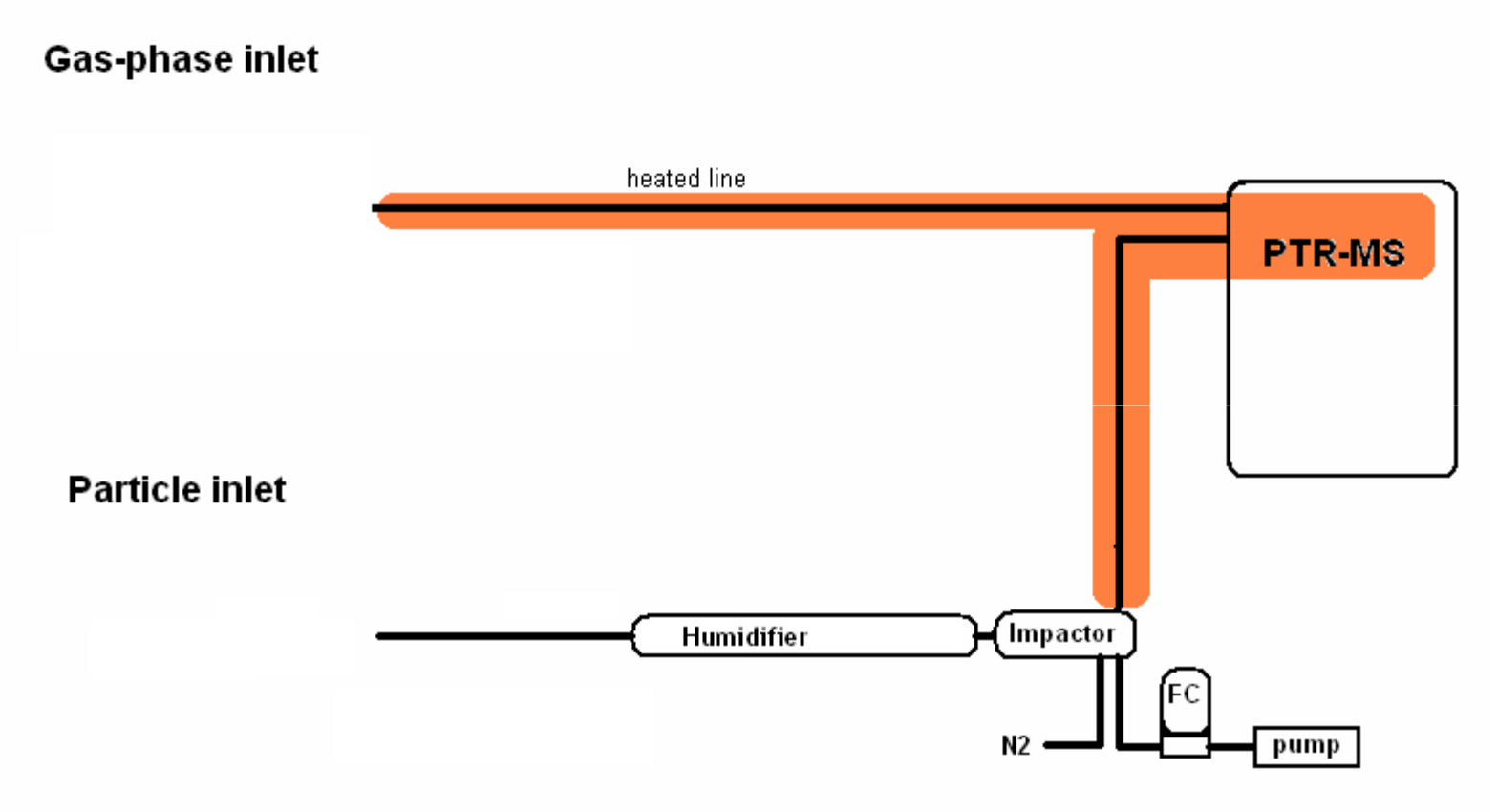
→ **Soft ionization, low fragmentation**

→ **High sensitivity**

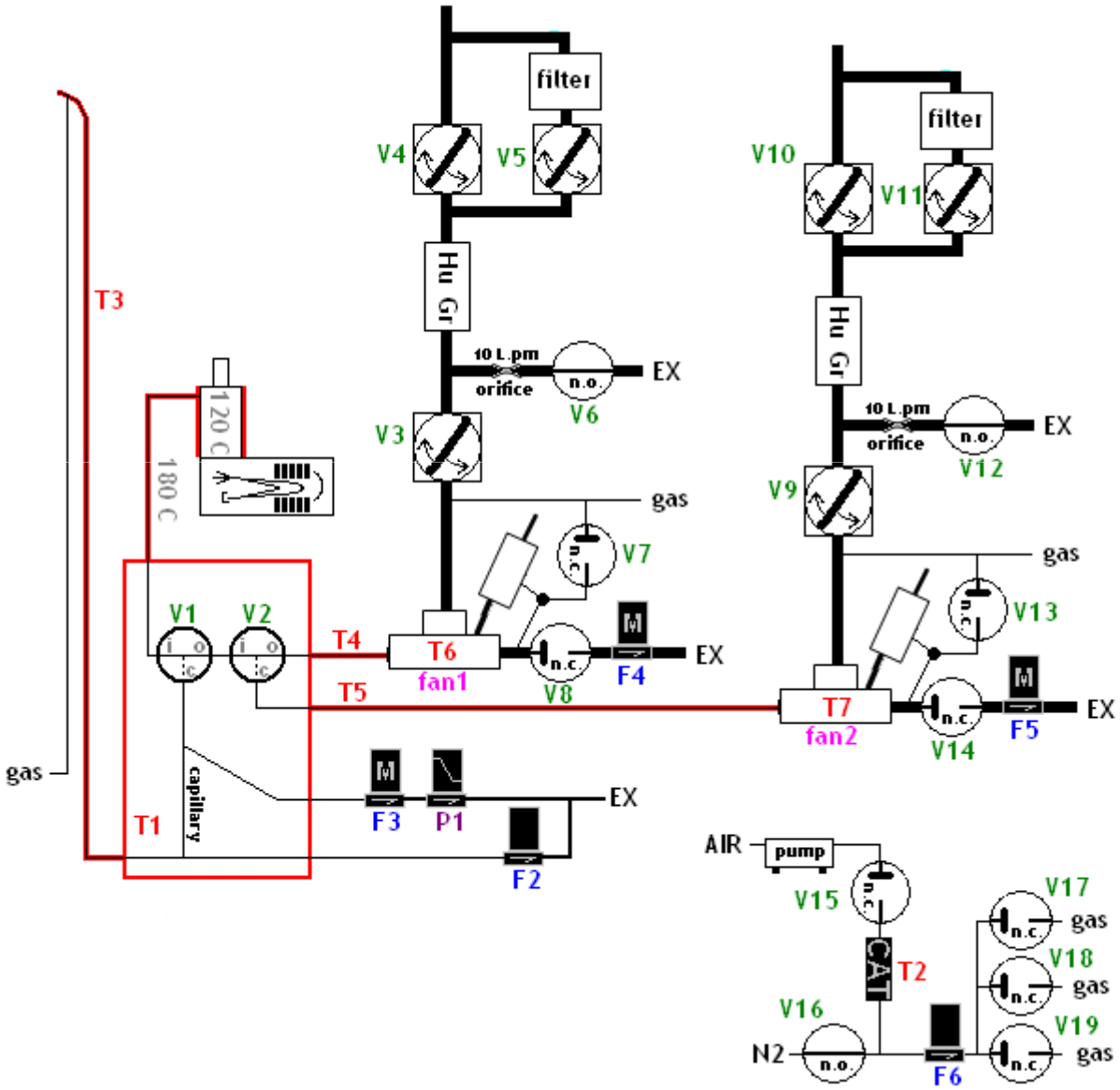
→ **Most organic species can be measured.**

→ **Quantitative for uncalibrated compounds.**

New approach: use PTR-MS for aerosols



Schematic of the new instrument



DO	
1	V1 on
2	V1 off
3	V2 on
4	V2 off
5	V3 on
6	V3 off
7	V4 on
8	V4 off
9	V5
10	V6, V8
11	V7
12	V9 on
13	V9 off
14	V10 on
15	V10 off
16	V11
17	V12, V14
18	V13
19	V15, V16
20	V17
21	V18
22	V19
23	T6 reset
24	T7 reset
25	T8 reset
26	T6 heatoff, fan1
27	T7 heatoff, fan2
28	T8 heatoff, fan3
29	
30	
31	
32	

AI	
1	F1
2	F2
3	F3
4	F4
5	F5
6	F6
7	P1
8	T6
9	T7
10	T8
11	relHum 1
12	relHum 2
13	
14	
15	
16	

AO	
1	F1
2	F2
3	F6
4	P1
5	
6	
7	
8	

Key advantages of the new instrument:

→Good time resolution and chemical characterization.

→Combined analysis of gas phase particulate chemical composition.

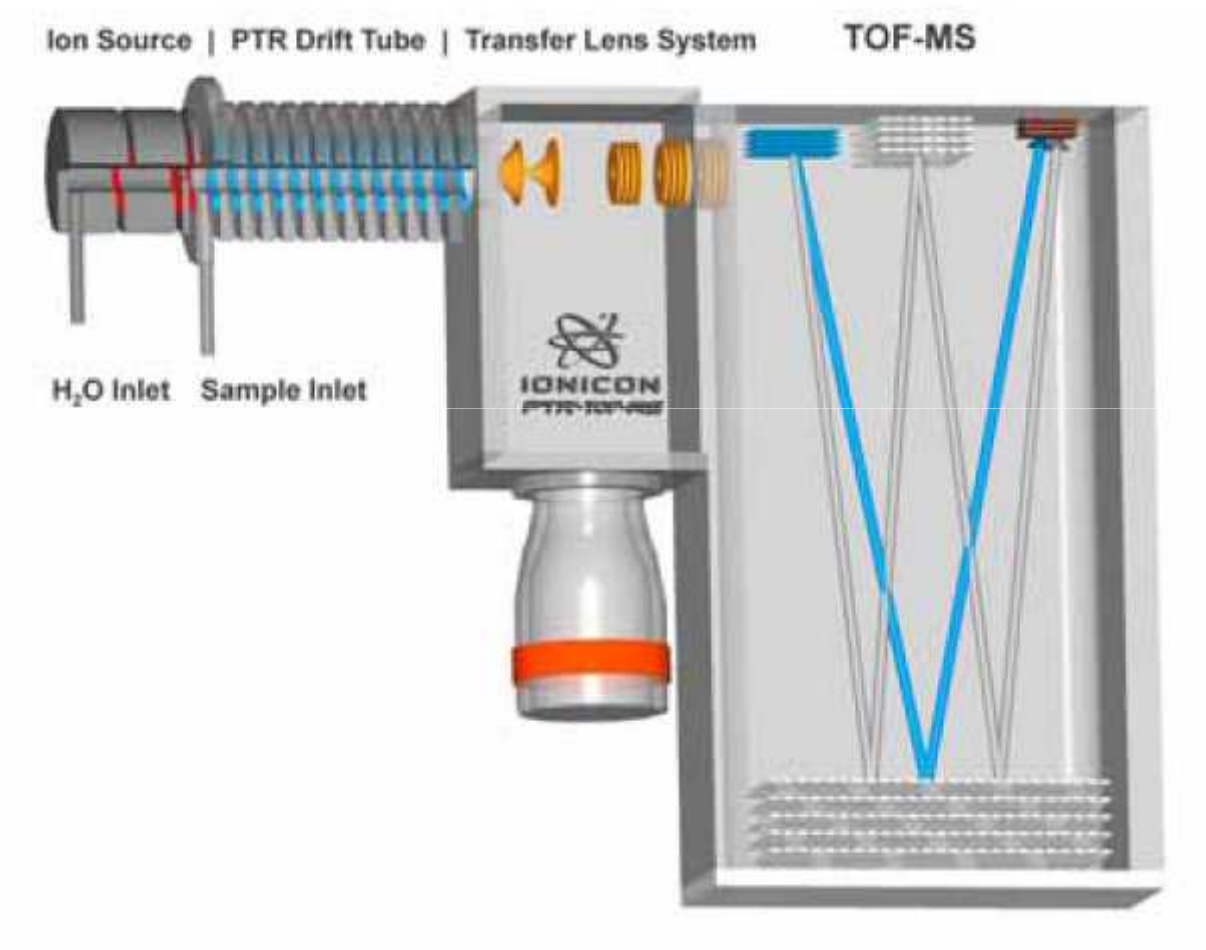
→High sensitivity (10 pg m-3) .

→Gas phase/particle partitioning.

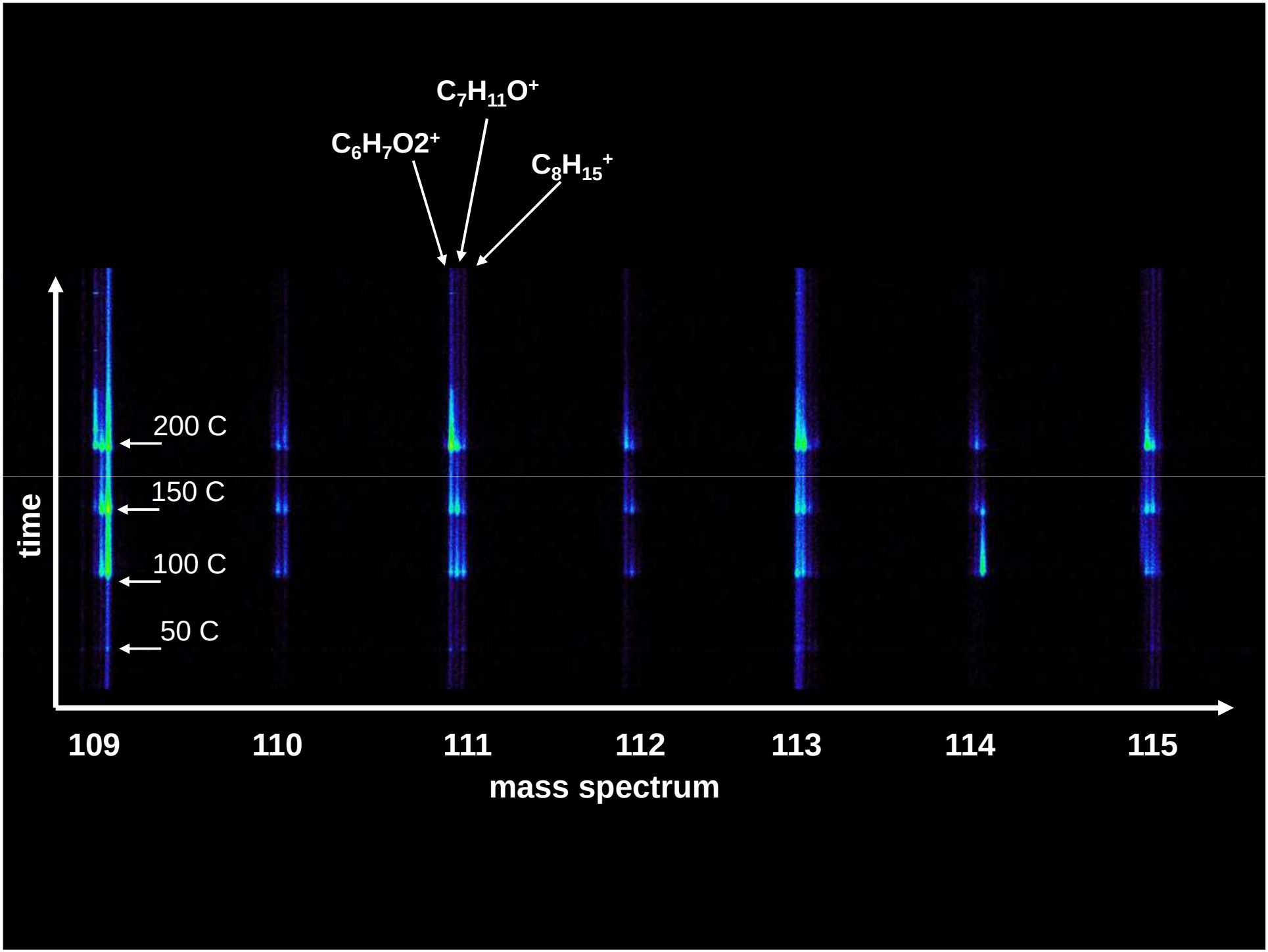
→Capability to measure on semivolatile compounds.

→ Comprehensive analysis of the totality of organics in air.

Proton-Transfer-Reaction Mass-Spectrometry

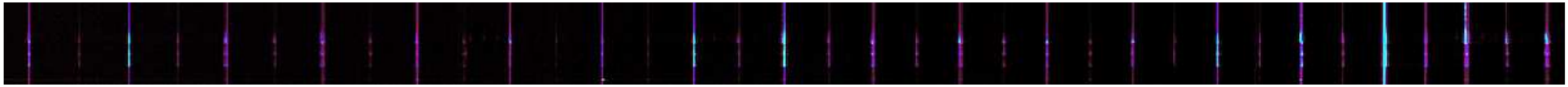


Resolves fractional mass difference of 37 mDa between CH4 and O components.

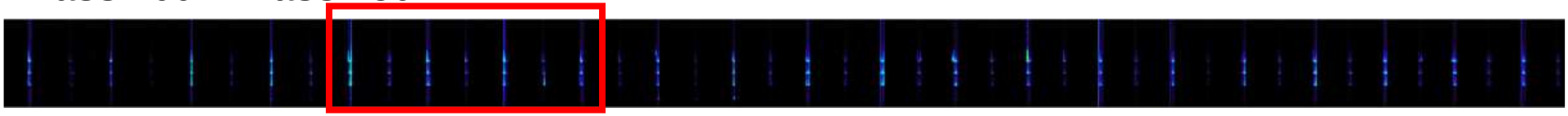

$C_7H_{11}O^+$
$C_6H_7O2^+$
$C_8H_{15}^+$
200 C
150 C
100 C
50 C
time
109
110
111
112
113
114
115
mass spectrum

A full spectrum:

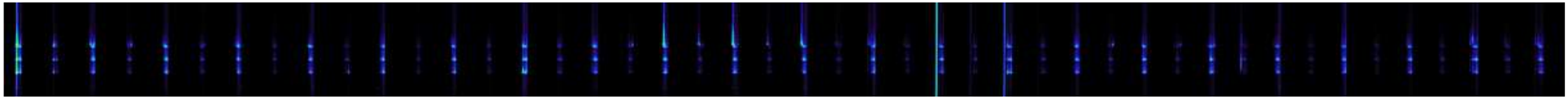
mass 60 – mass 100:



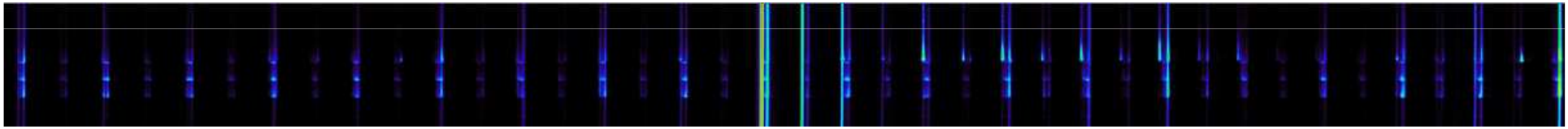
mass 100 – mass 150:



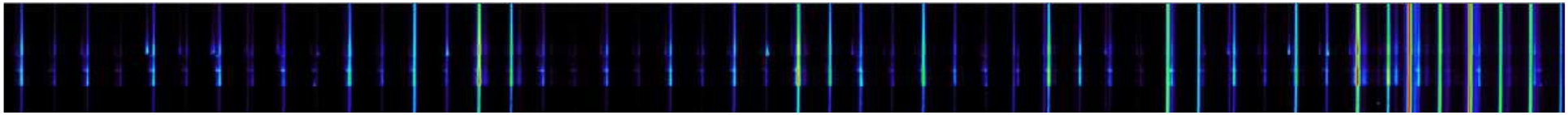
mass 150 – mass 200:



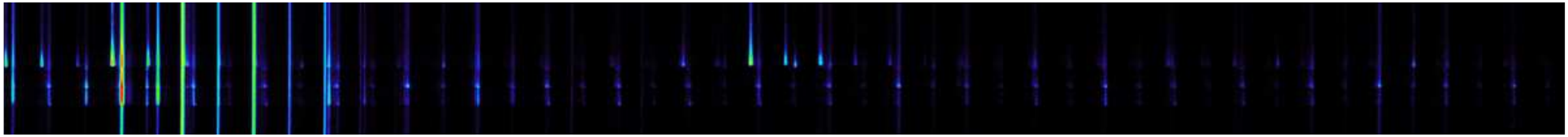
mass 200 – mass 250:



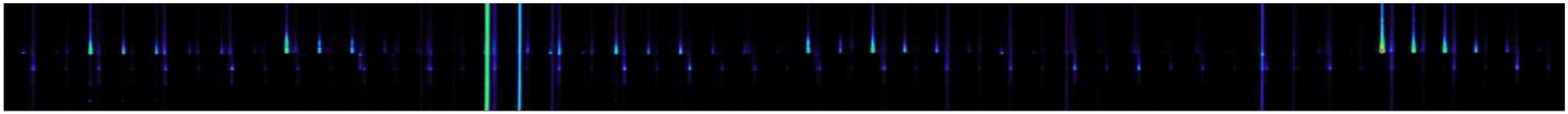
mass 250 – mass 300:



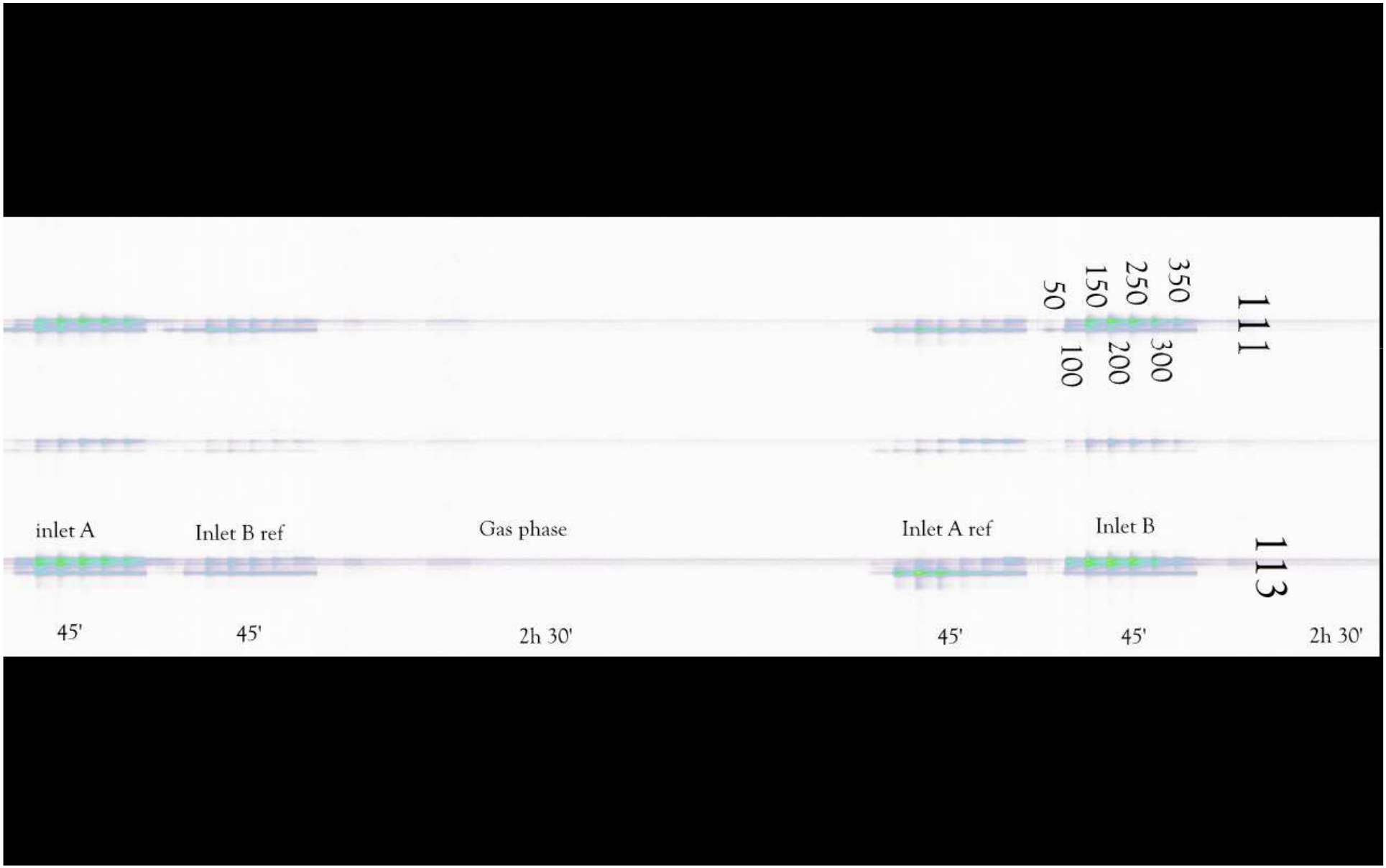
mass 300 – mass 350:



mass 350 – mass 400:



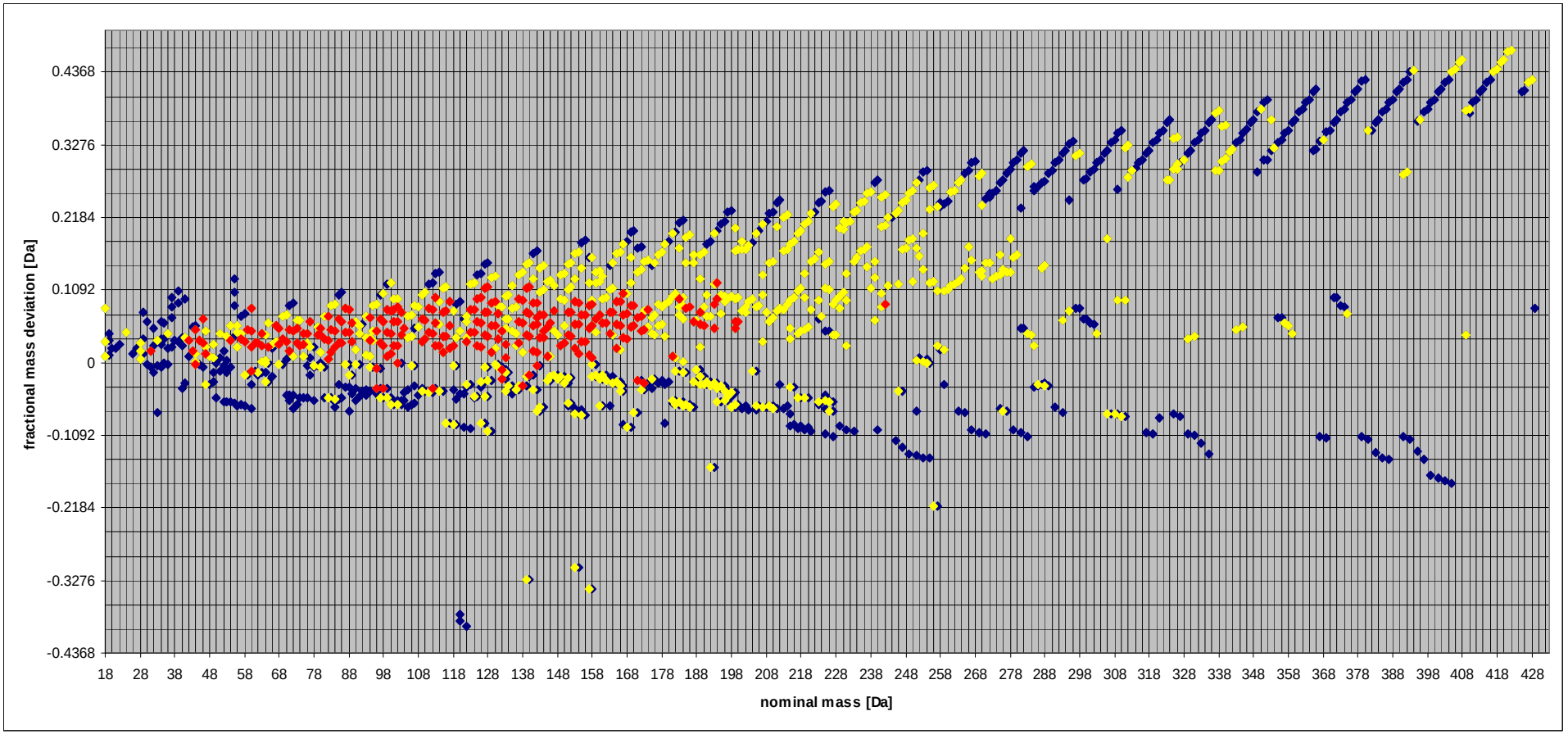
The instrument cycle:



All Masses detected:

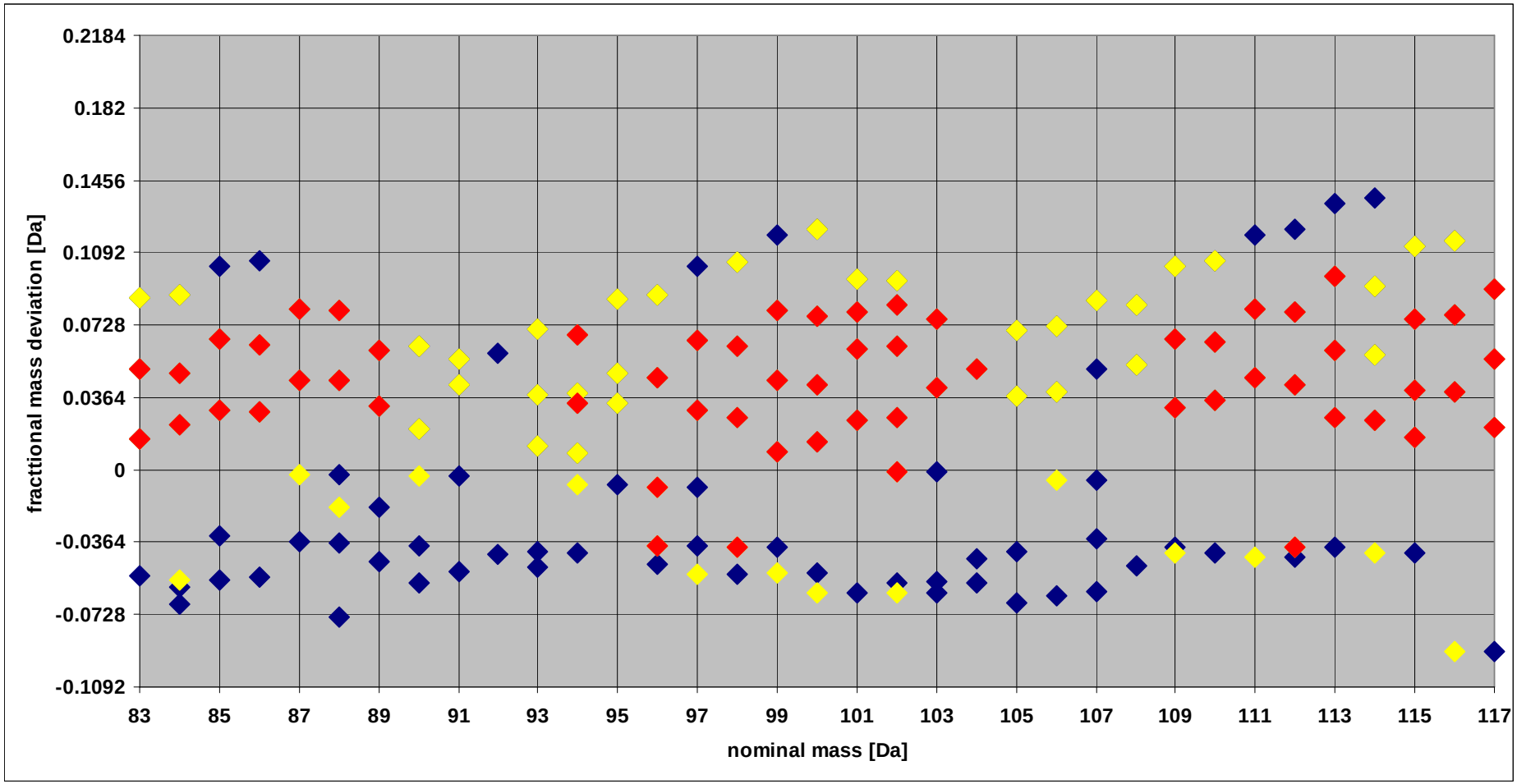
Yellow: <10% of measurements above detection limit

Red: <50% of measurements above detection limit



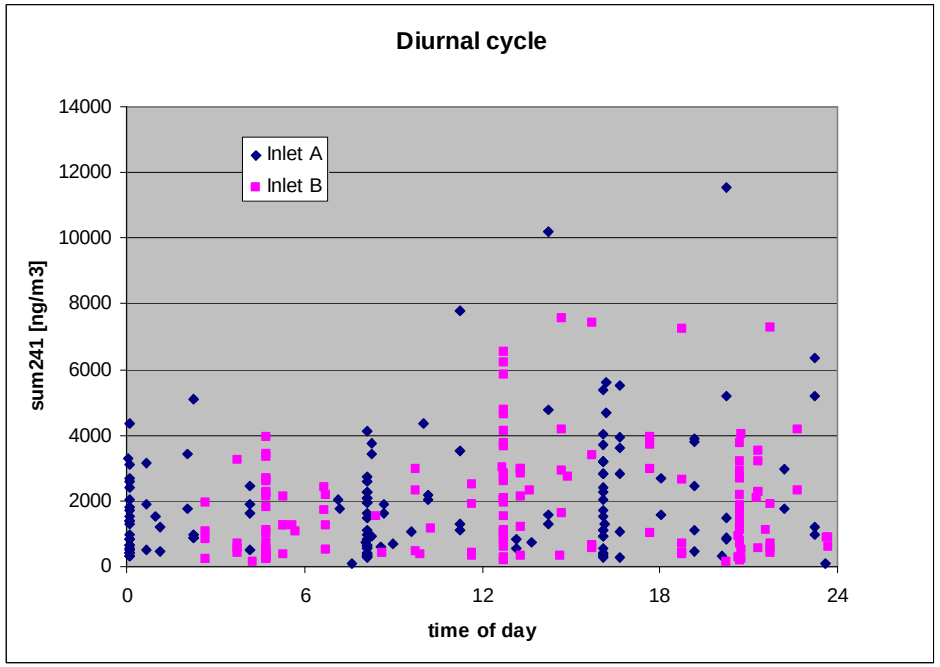
Detection limit: Median + 3 times standard deviation of background measurements

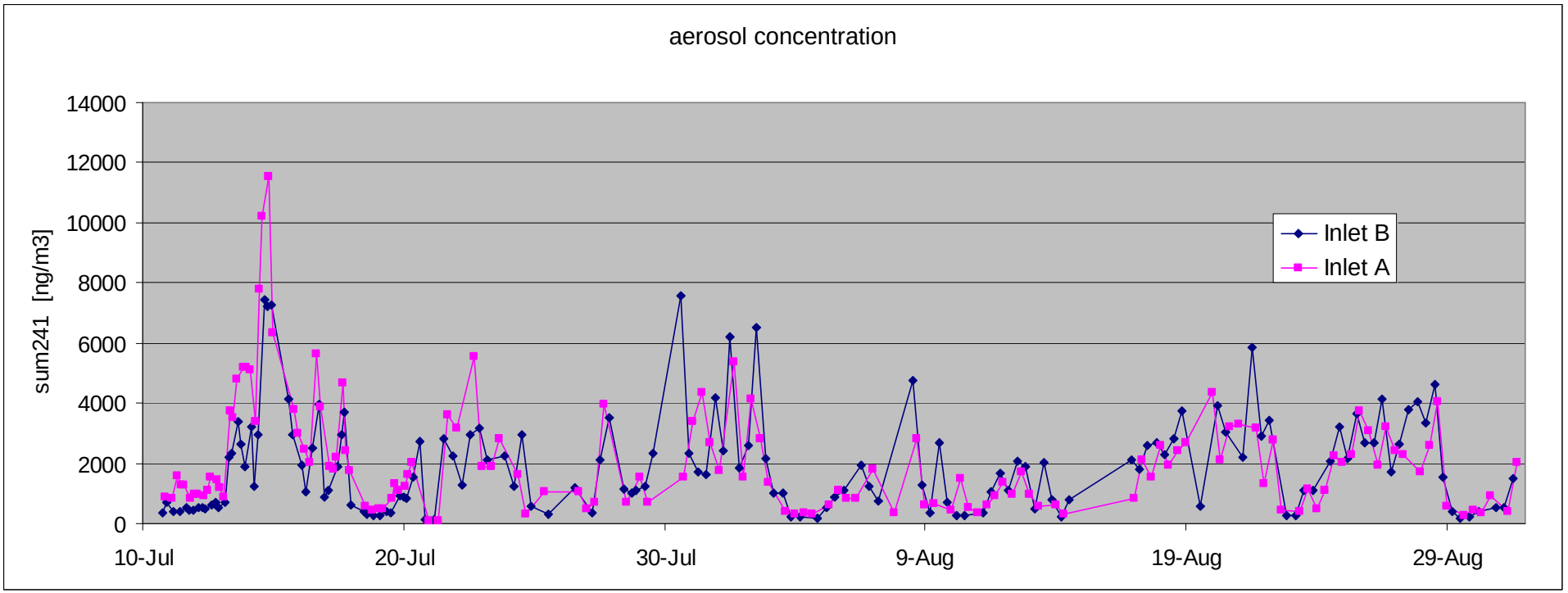
Oxygenated compounds :



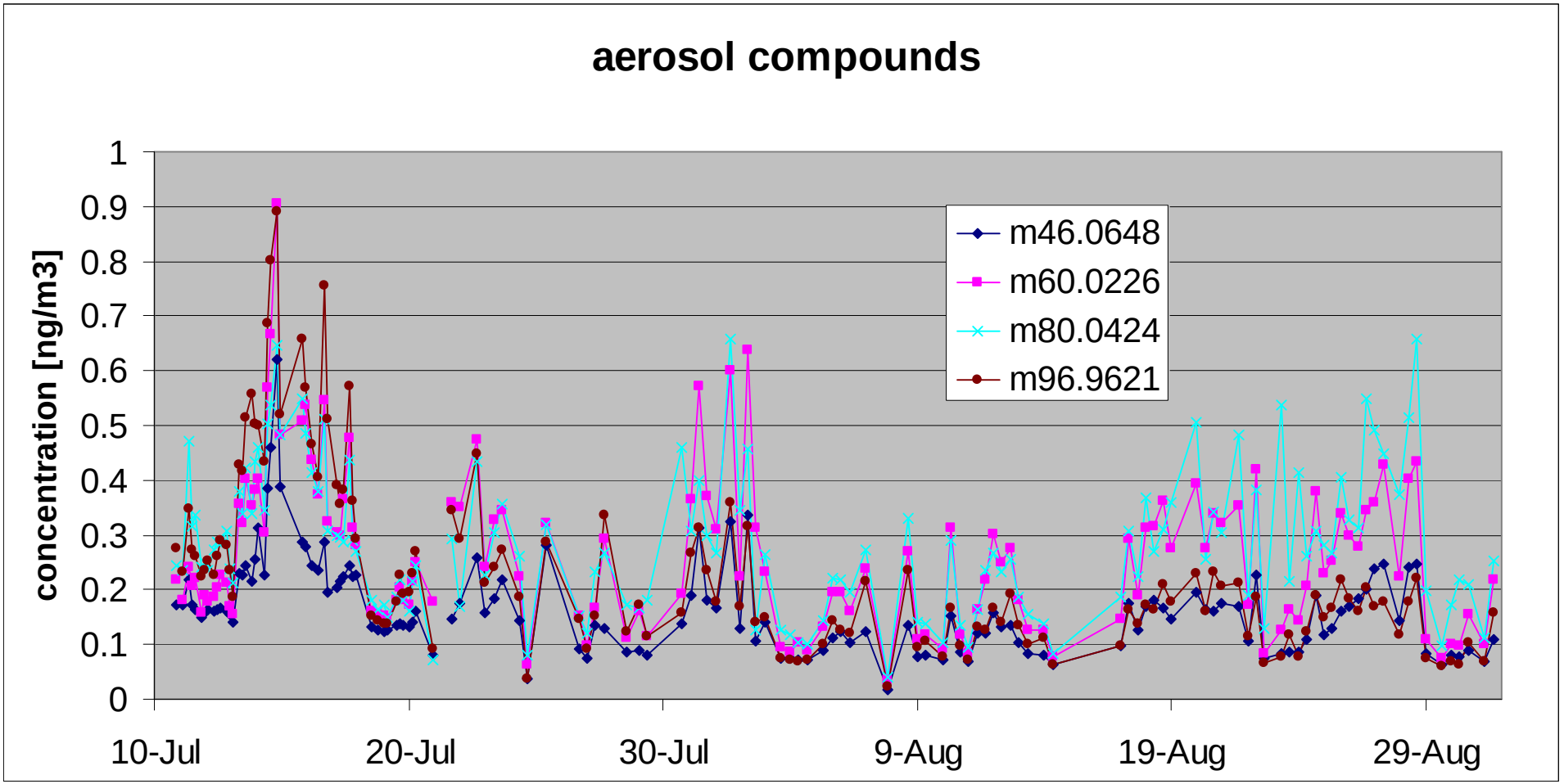
Mass CH4:	16.031
Mass O:	15.995
Δm:	36.4 mDa

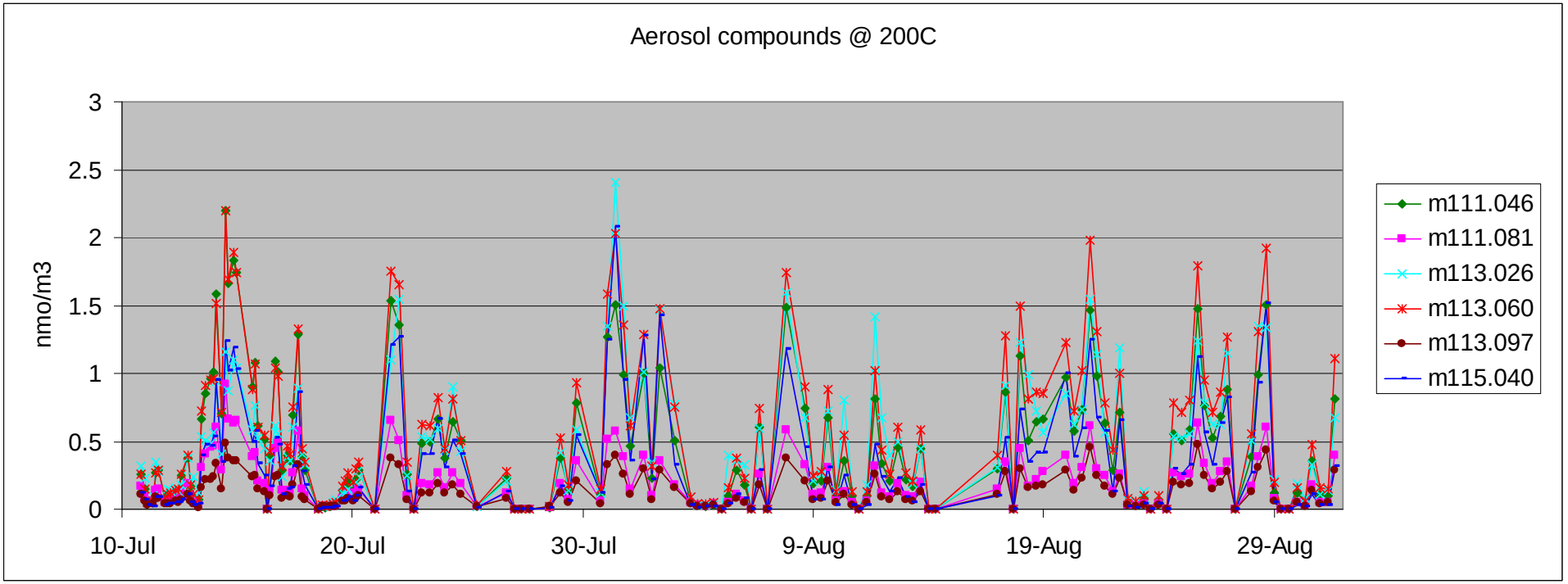
Time rows- Total Organics

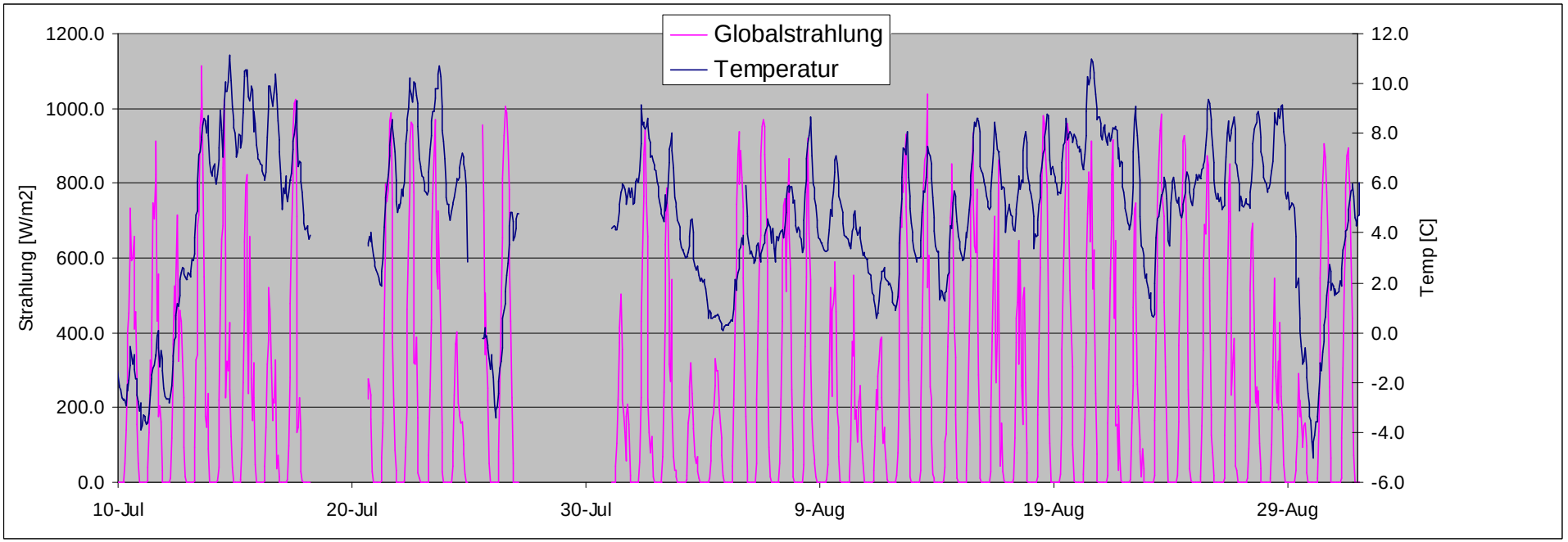


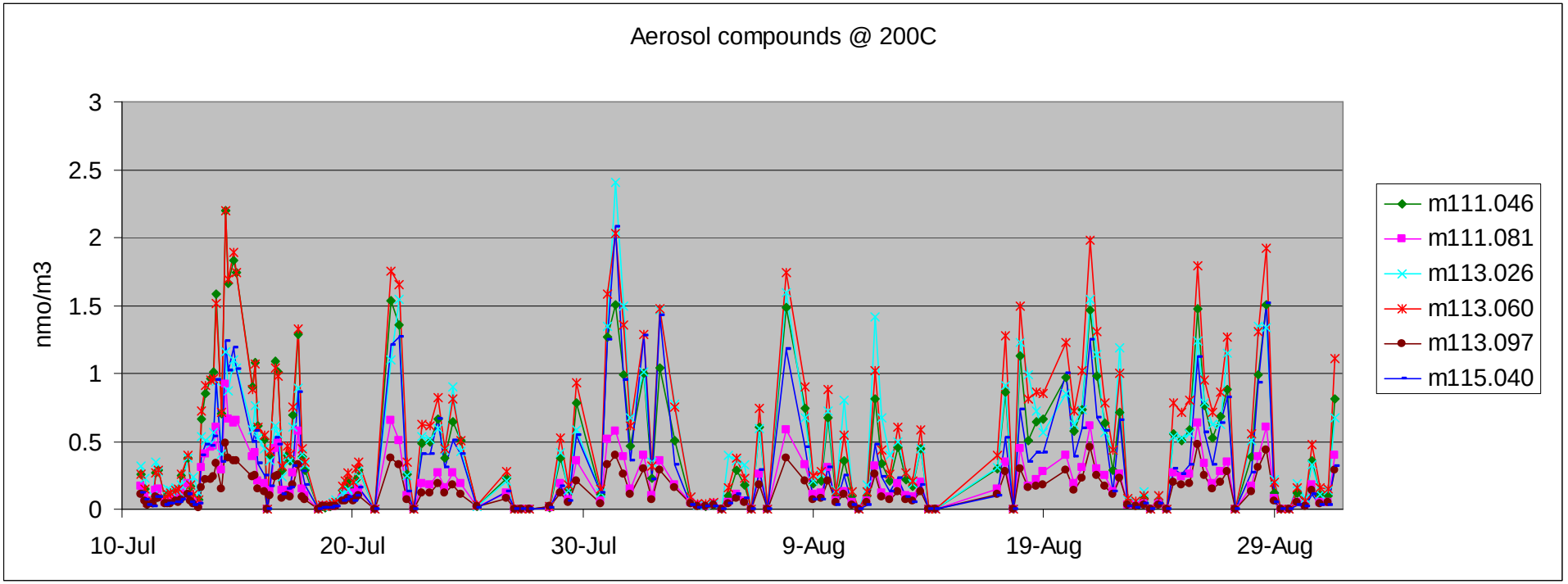


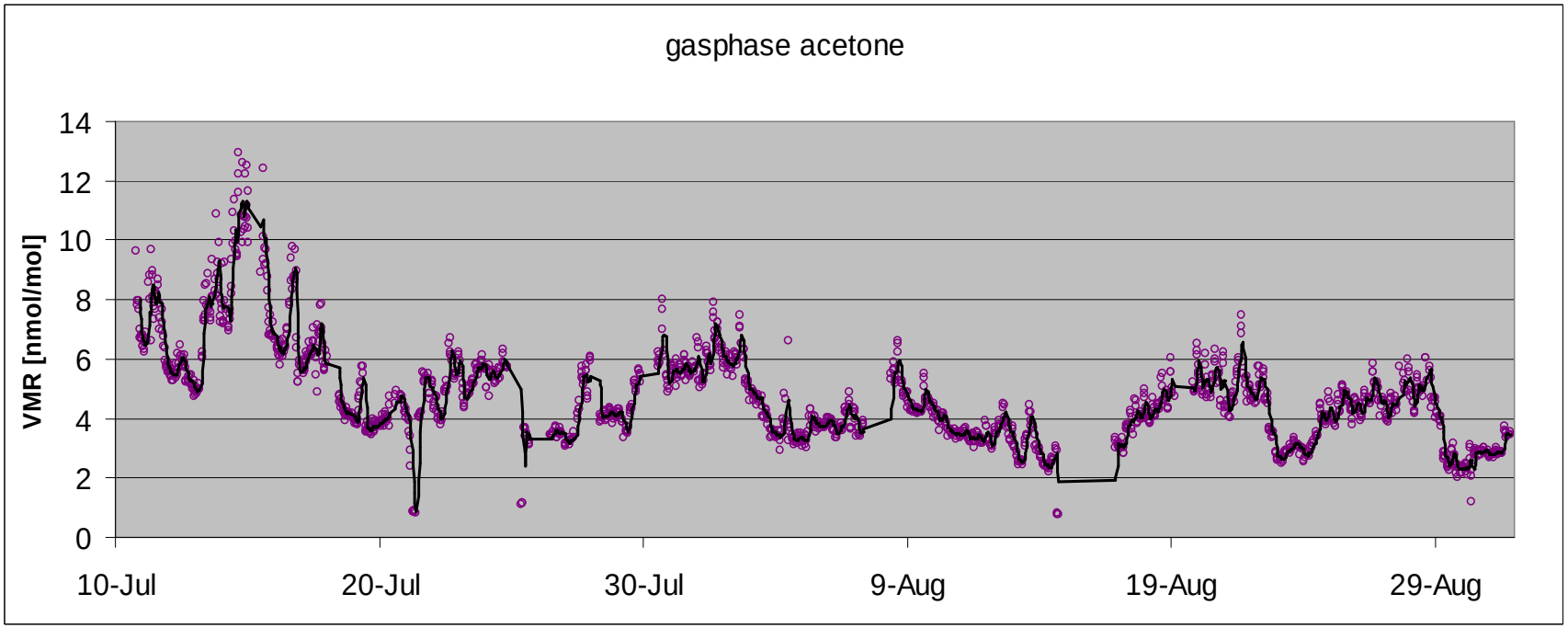
Time rows- the lowest concentrations

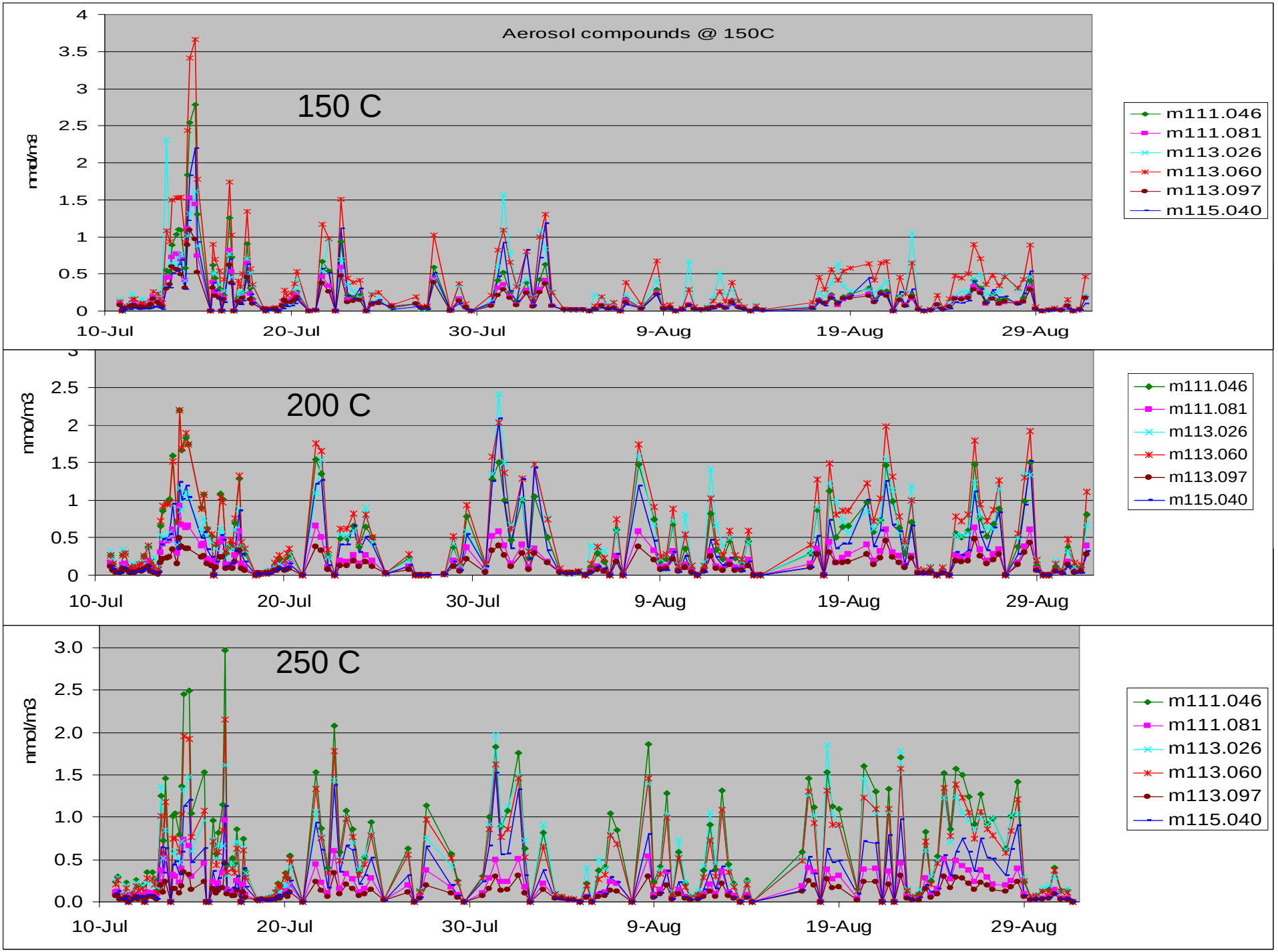



Aerosol compounds @ 200C
nmo/m3
3
2.5
2
1.5
1
0.5
0
10-Jul
20-Jul
30-Jul
9-Aug
19-Aug
29-Aug
m111.046
m111.081
m113.026
m113.060
m113.097
m115.040


Globalstrahlung
Temperatur
Strahlung [W/m2]
Temp [C]
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
10-Jul
20-Jul
30-Jul
9-Aug
19-Aug
29-Aug


Aerosol compounds @ 200C
nmo/m3
3
2.5
2
1.5
1
0.5
0
10-Jul
20-Jul
30-Jul
9-Aug
19-Aug
29-Aug
m111.046
m111.081
m113.026
m113.060
m113.097
m115.040


gasphase acetone
VMR [nmol/mol]
14
12
10
8
6
4
2
0
10-Jul
20-Jul
30-Jul
9-Aug
19-Aug
29-Aug


Aerosol compounds @ 150C
150 C
200 C
250 C
nmol/m3
m111.046
m111.081
m113.026
m113.060
m113.097
m115.040
10-Jul
20-Jul
30-Jul
9-Aug
19-Aug
29-Aug

Future work – in depth analysis:

Aerosol ageing/chemistry:
→Thermograms
→Degree of oxygenation
→Cloud processing

Source regions/strengths:
→Marker compounds?
→Trajectory analysis

Interaction with gasphase:
→Diurnal cycle
→Partitioning