Continuous and integrated monitoring of rural atmospheric mercury levels in the UK.

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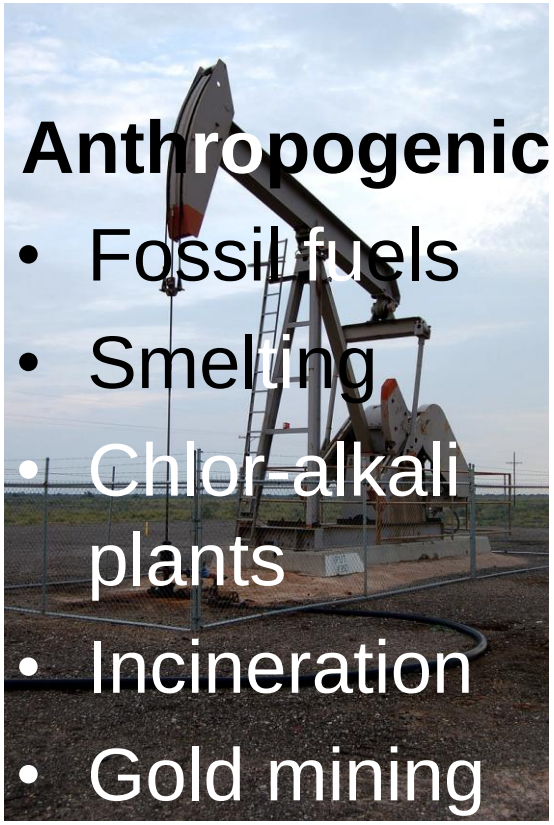
Where does the mercury come from?



Anthropogenic

- Fossil fuels
- Smelting
- Chlor-alkali plants
- Incineration
- Gold mining

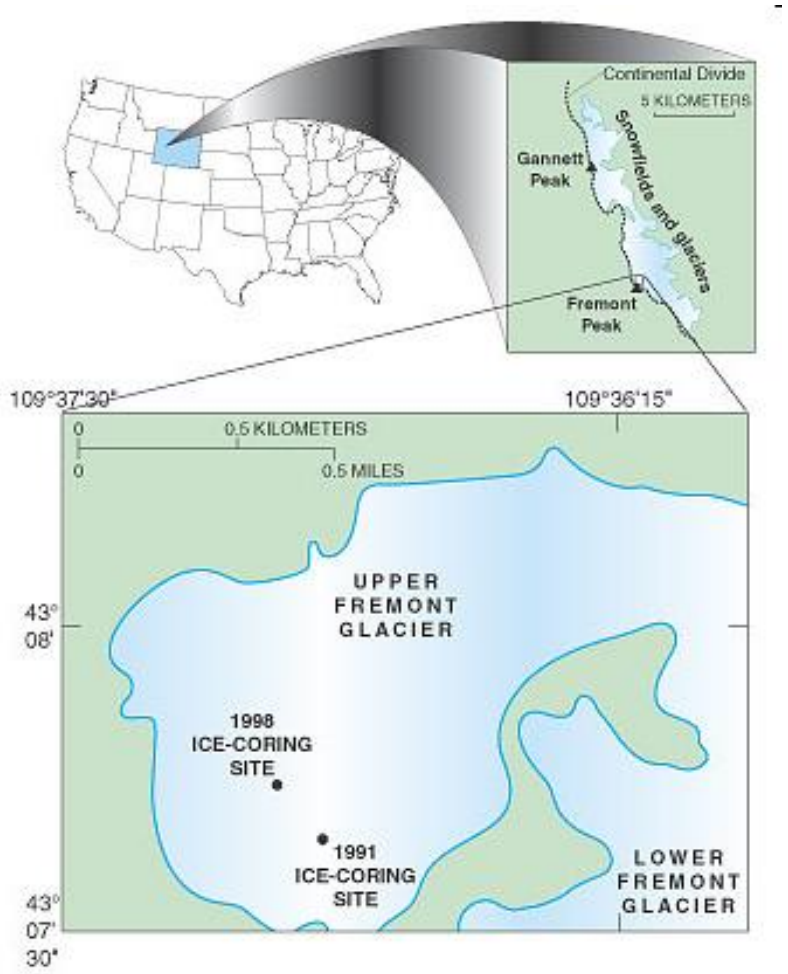
Natural

- Fresh & salt water bodies
- Volcanoes
- Soils
- Vegetation

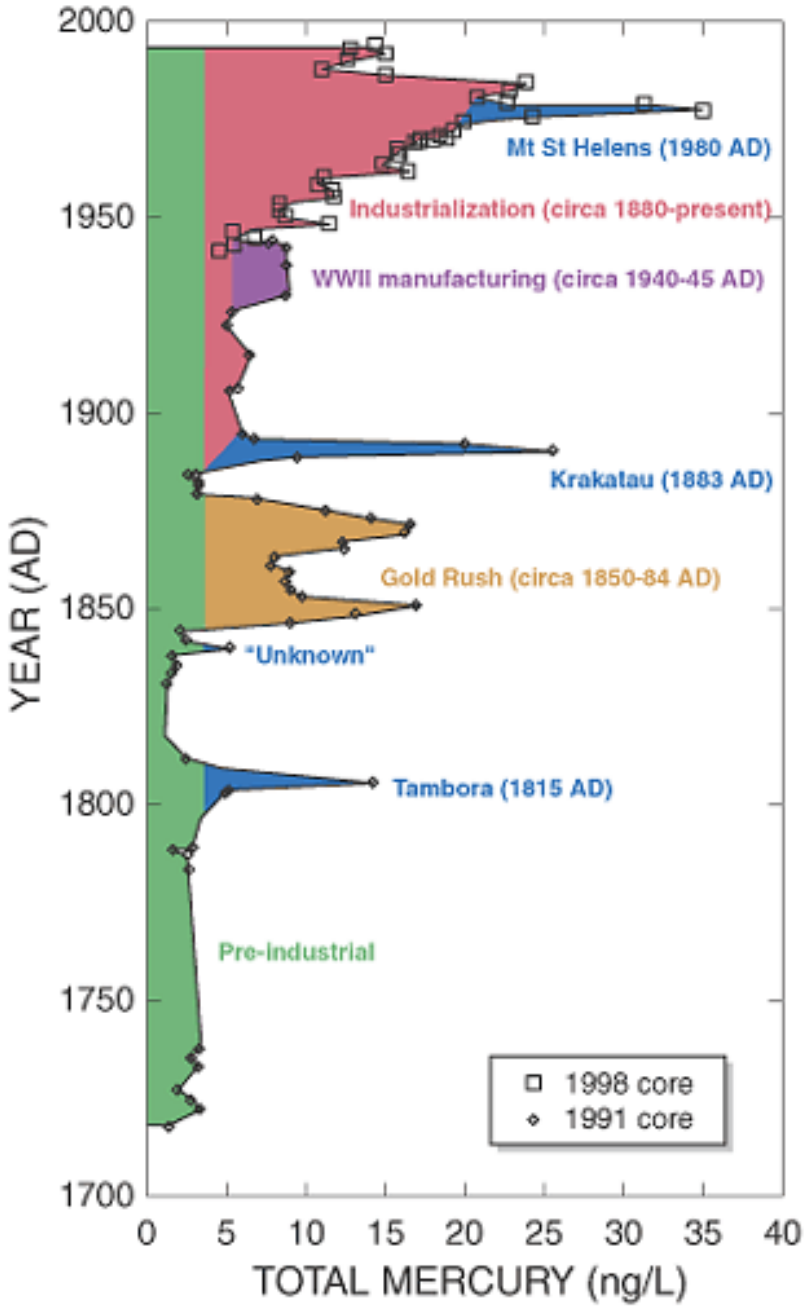
What is atmospheric mercury?

- Hg^0
- RGM
- Hg^P

Mercury Levels:



US Geological Survey (2002)



Why monitor?

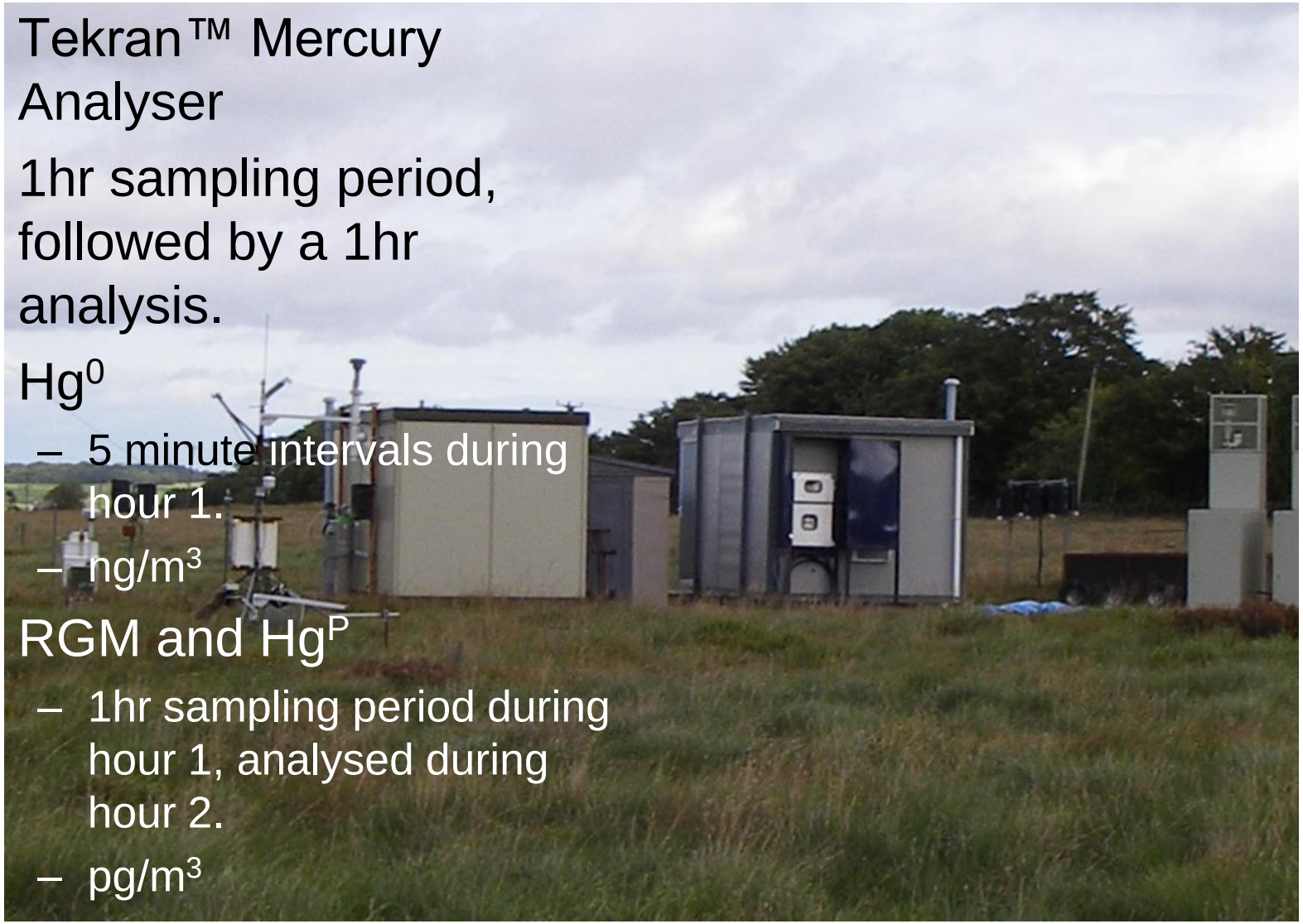
- Part of the EU's Air Quality Framework directive: 4th daughter directive relating to As, Cd, Hg, Ni and PAHs in ambient air.
- Recognises mercury as
  - Hazardous substance for human health and the environment
  - Capacity to accumulate up food chains
  - Long range transport potential.
- Aims to reduce mercury in aquatic and terrestrial ecosystems and thus reduce intake via food as well as mercury containing products.
- Monitored as part of EMEP (European Monitoring and Evaluation of Pollutants.)

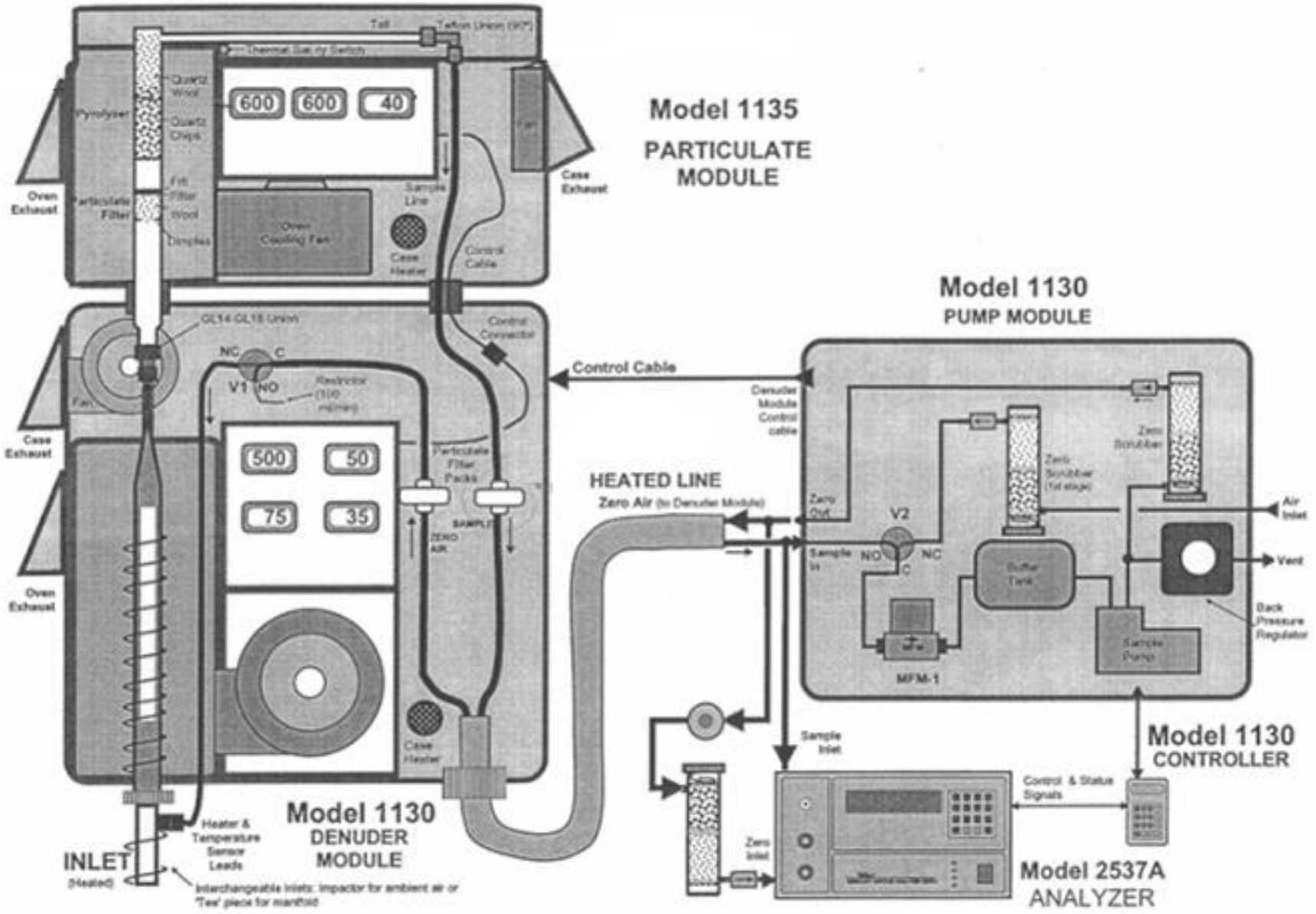
Sampling method

- Tekran™ Mercury Analyser
- 1hr sampling period, followed by a 1hr analysis.
- Hg^0
  - 5 minute intervals during hour 1.
  - ng/m^3

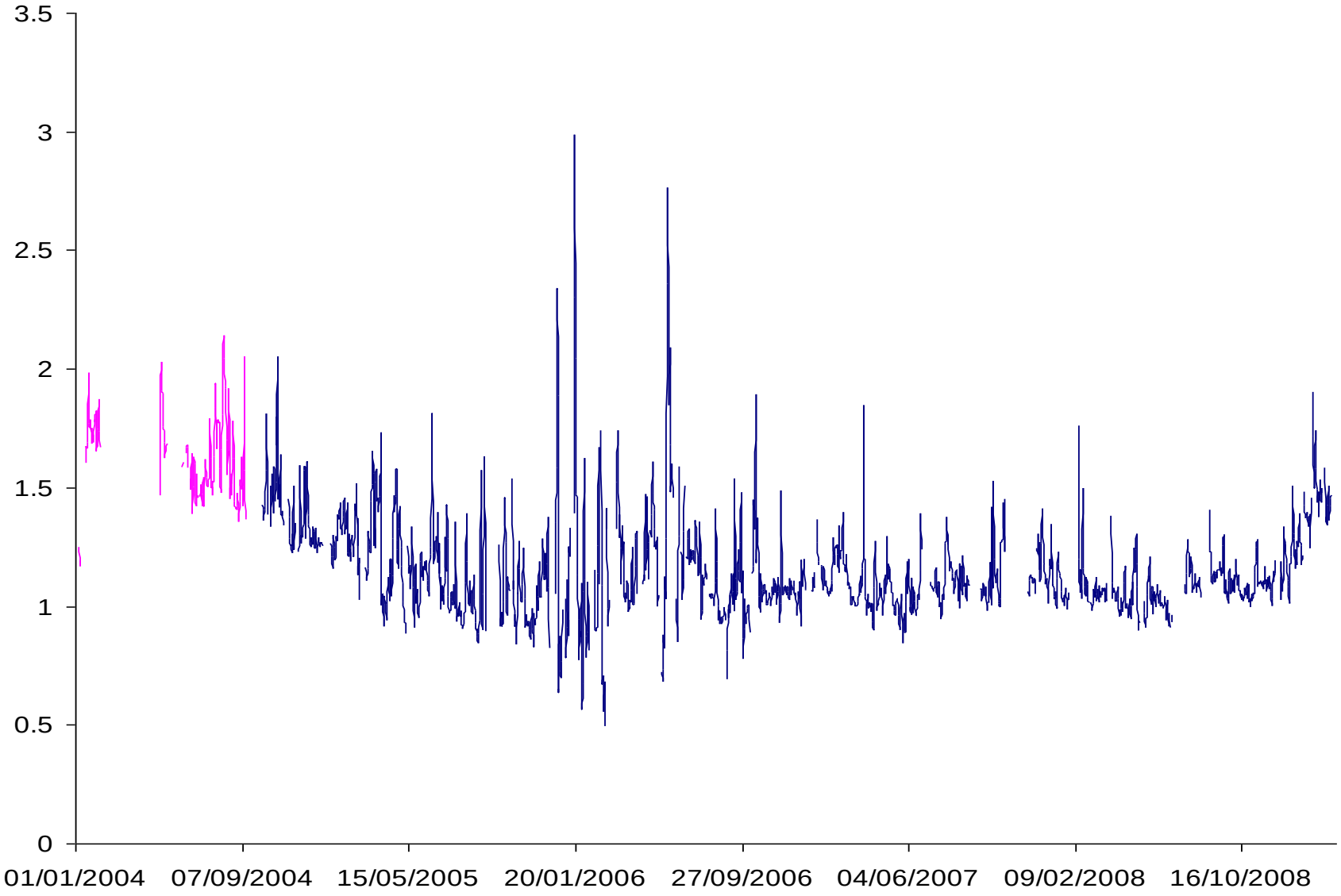
RGM and Hg^P

- 1hr sampling period during hour 1, analysed during hour 2.
- pg/m^3

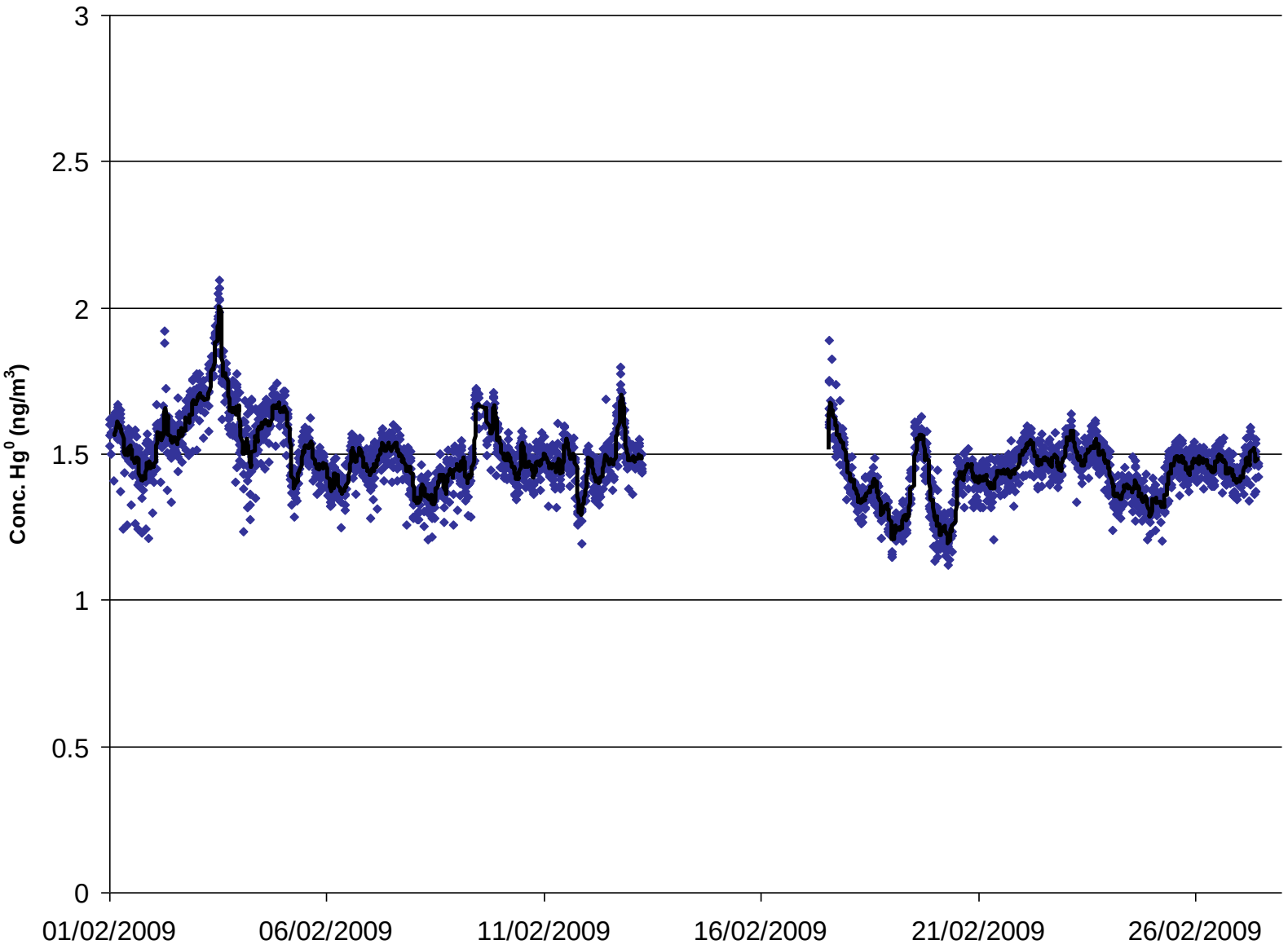



Model 1135
PARTICULATE MODULE
Model 1130
PUMP MODULE
Control Cable
HEATED LINE
Zero Air (to Denuder Module)
Model 1130
DENUDER MODULE
INLET
(Heated)
Model 1130
CONTROLLER
Model 2537A
ANALYZER
MFM-1
Oven Exhaust
Case Exhaust
Pyrolyser
Quartz Wool
Quartz Chips
Particulate Filter
Oven Cooling Fan
Case Heater
Control Cable
Control Connector
Fan
Restrictor
Particulate Filter Packs
Heater & Temperature Sensor Leads
Interchangeable inlets: impactor for ambient air or 'Tee' piece for manifold
Denuder Module Control cable
Zero Out
Sample In
Air Inlet
Vent
Back Pressure Regulator
Buffer Tank
Sample Pump
Sample Inlet
Zero Inlet
Control & Status Signals

Elemental Mercury

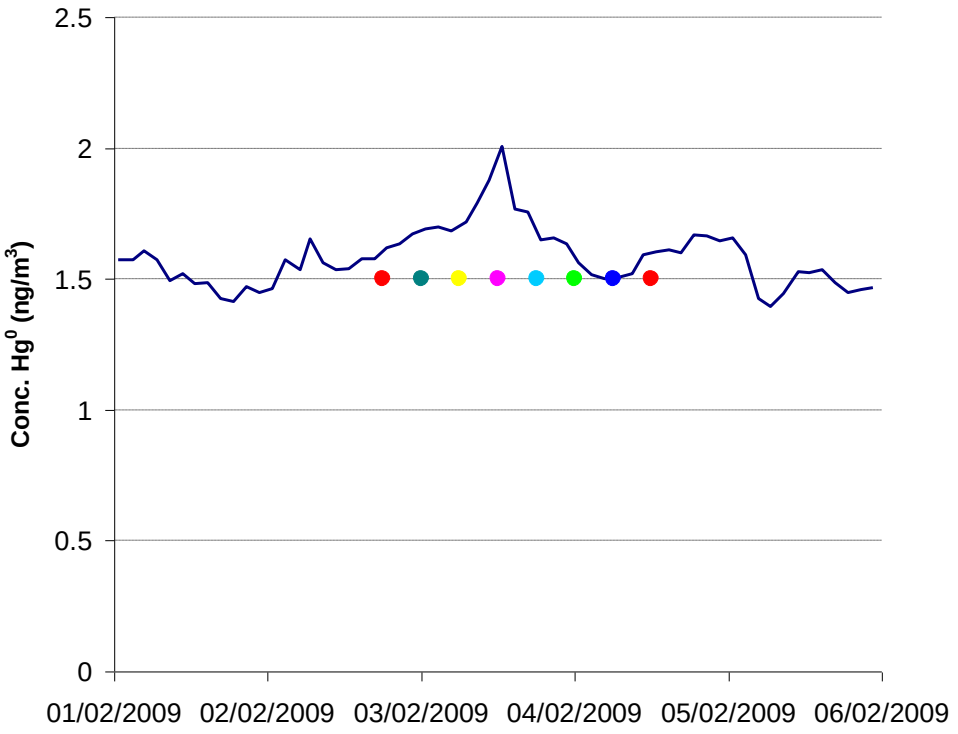


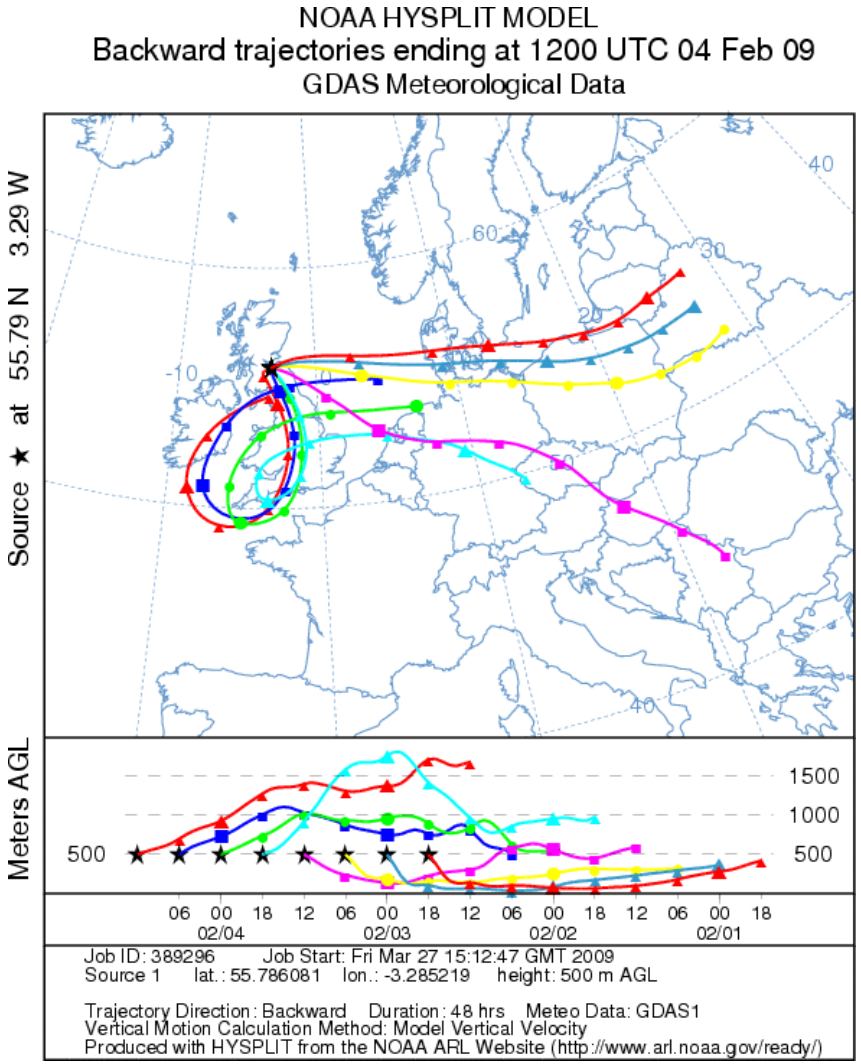
Elemental Mercury: Peak Event



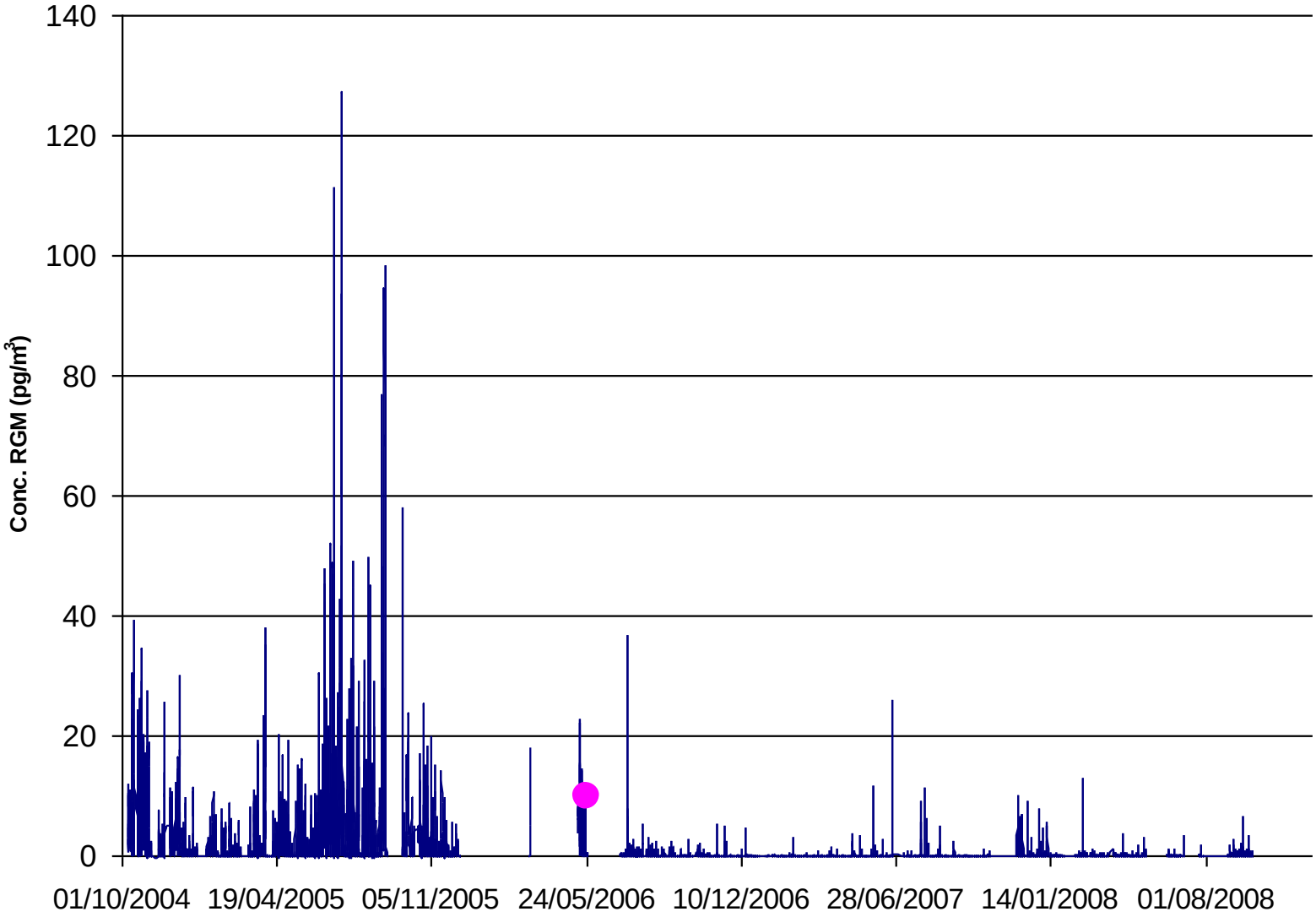
Elemental Mercury

Air Resources Laboratory back trajectory for air masses arriving at Auchencorth Moss, 1st-6th February 2009.

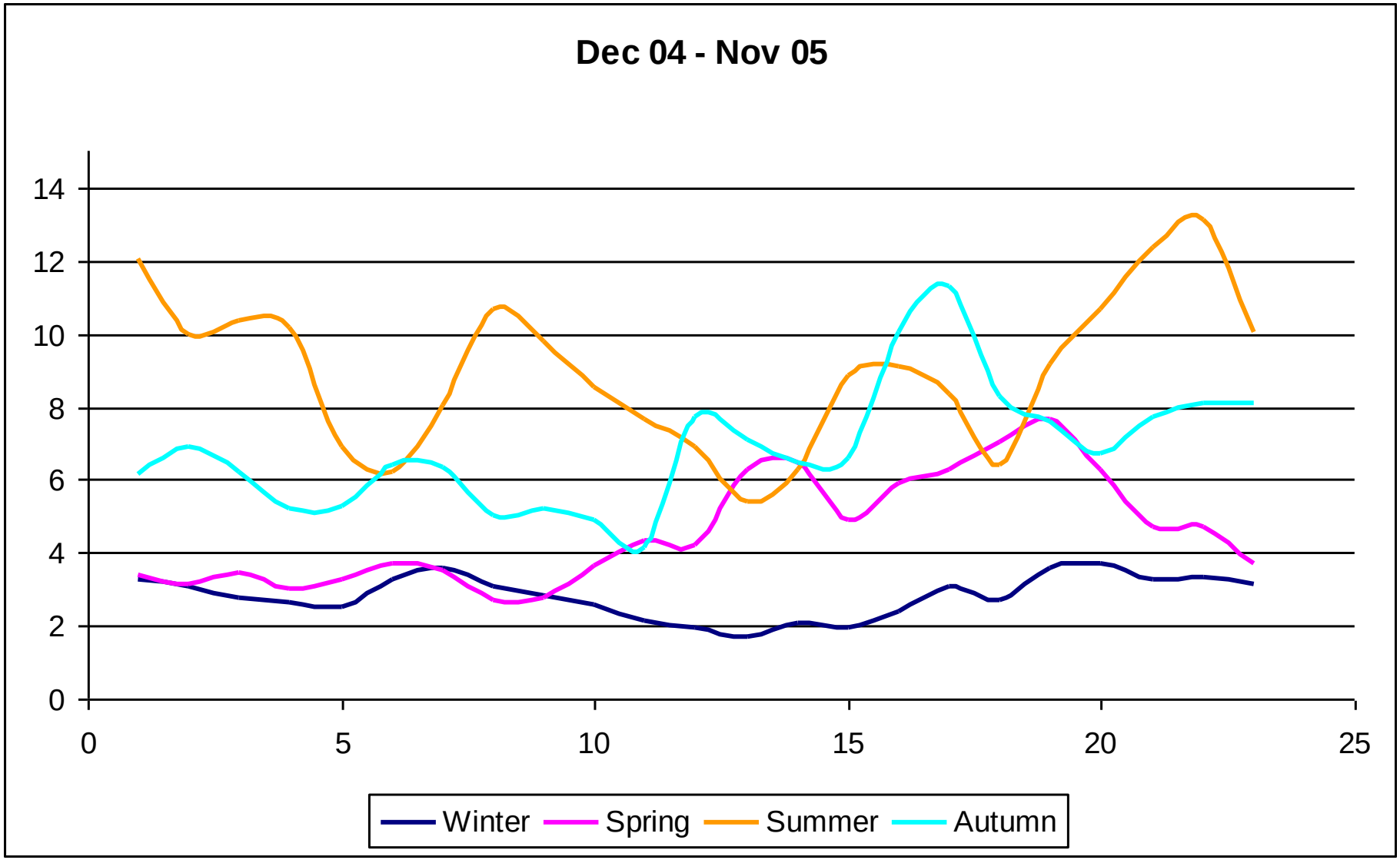




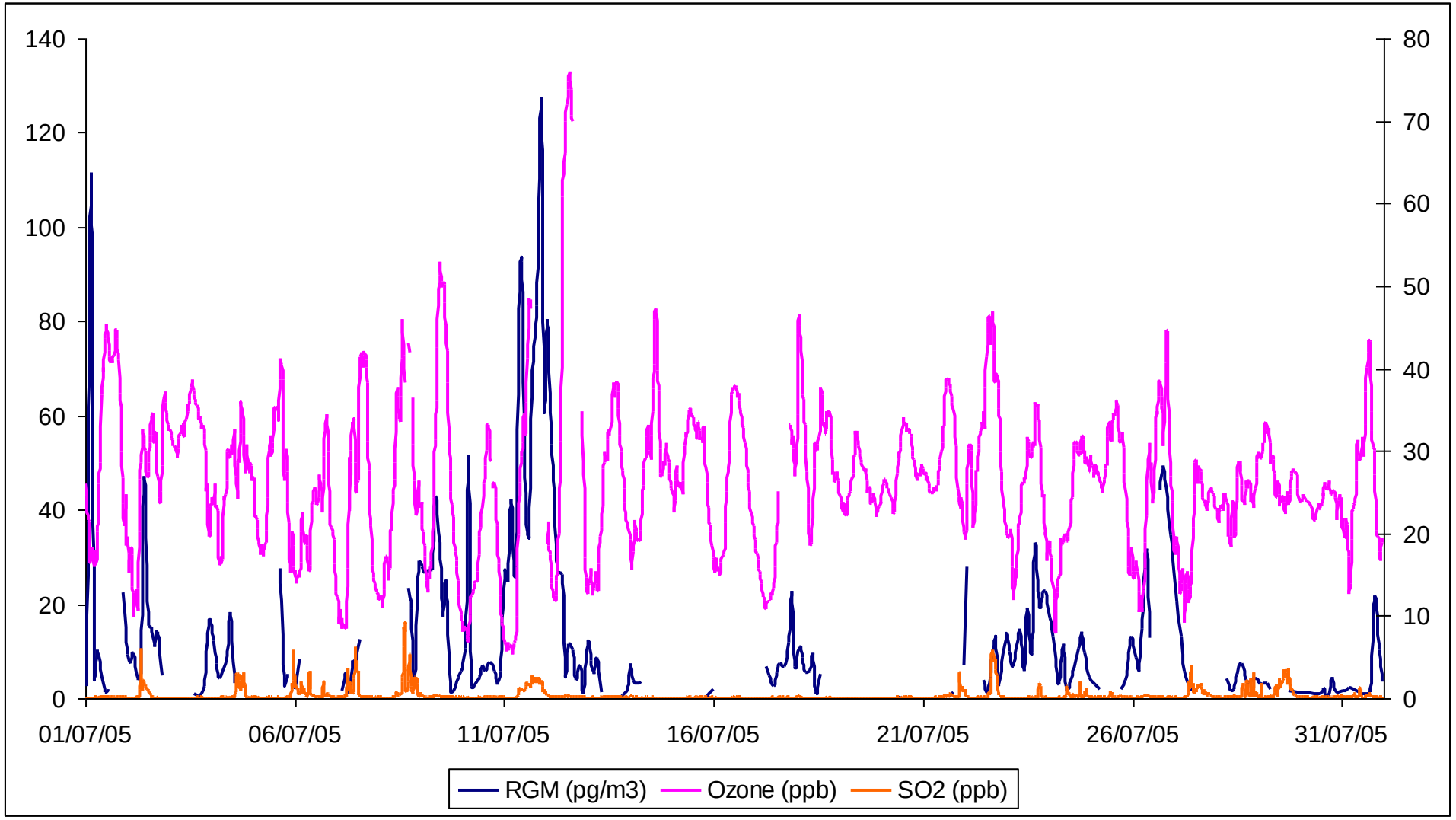
RGM


140
120
100
80
60
40
20
0
Conc. RGM (pg/m3)
01/10/2004
19/04/2005
05/11/2005
24/05/2006
10/12/2006
28/06/2007
14/01/2008
01/08/2008

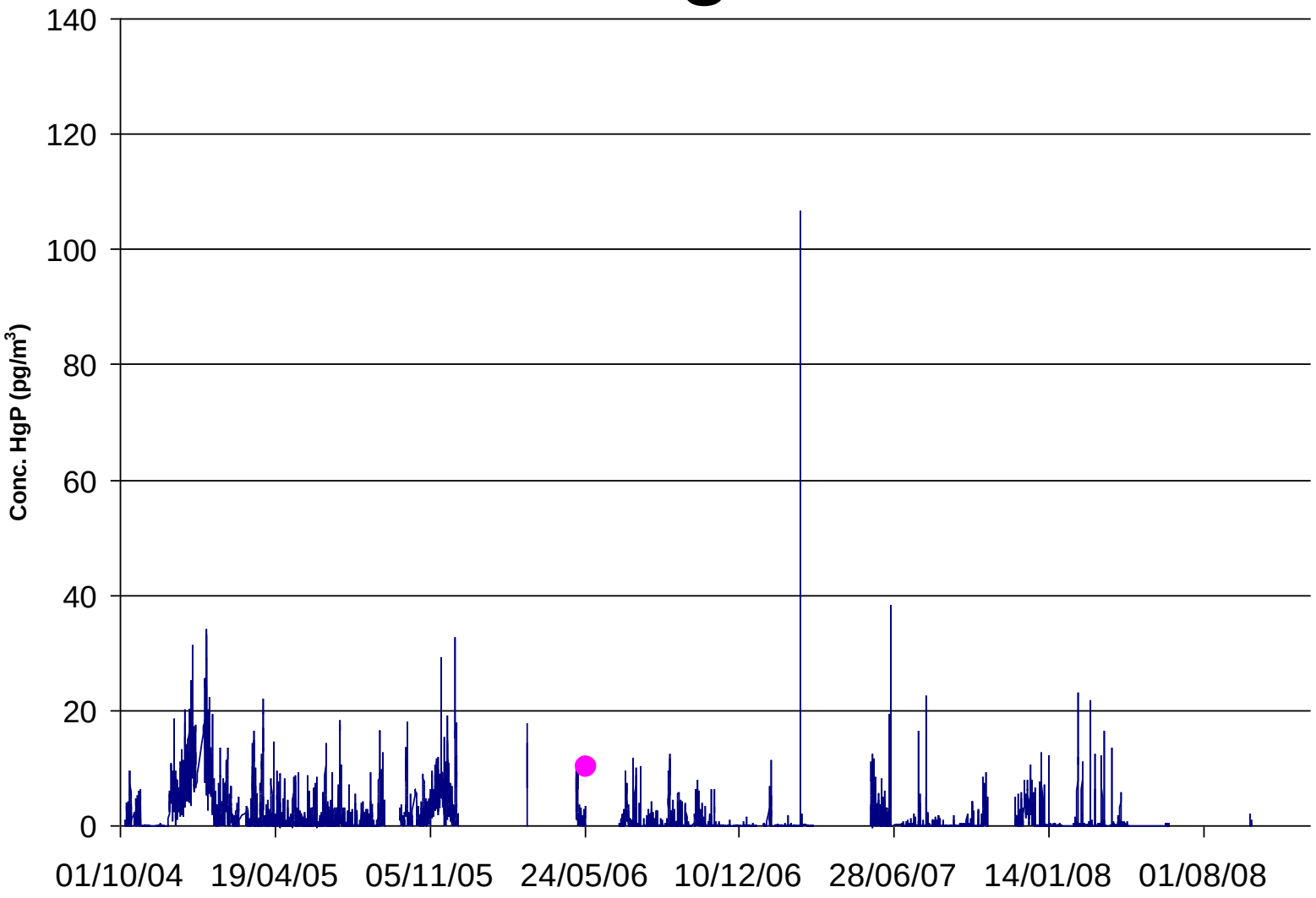
RGM


Dec 04 - Nov 05
14
12
10
8
6
4
2
0
0
5
10
15
20
25
Winter
Spring
Summer
Autumn

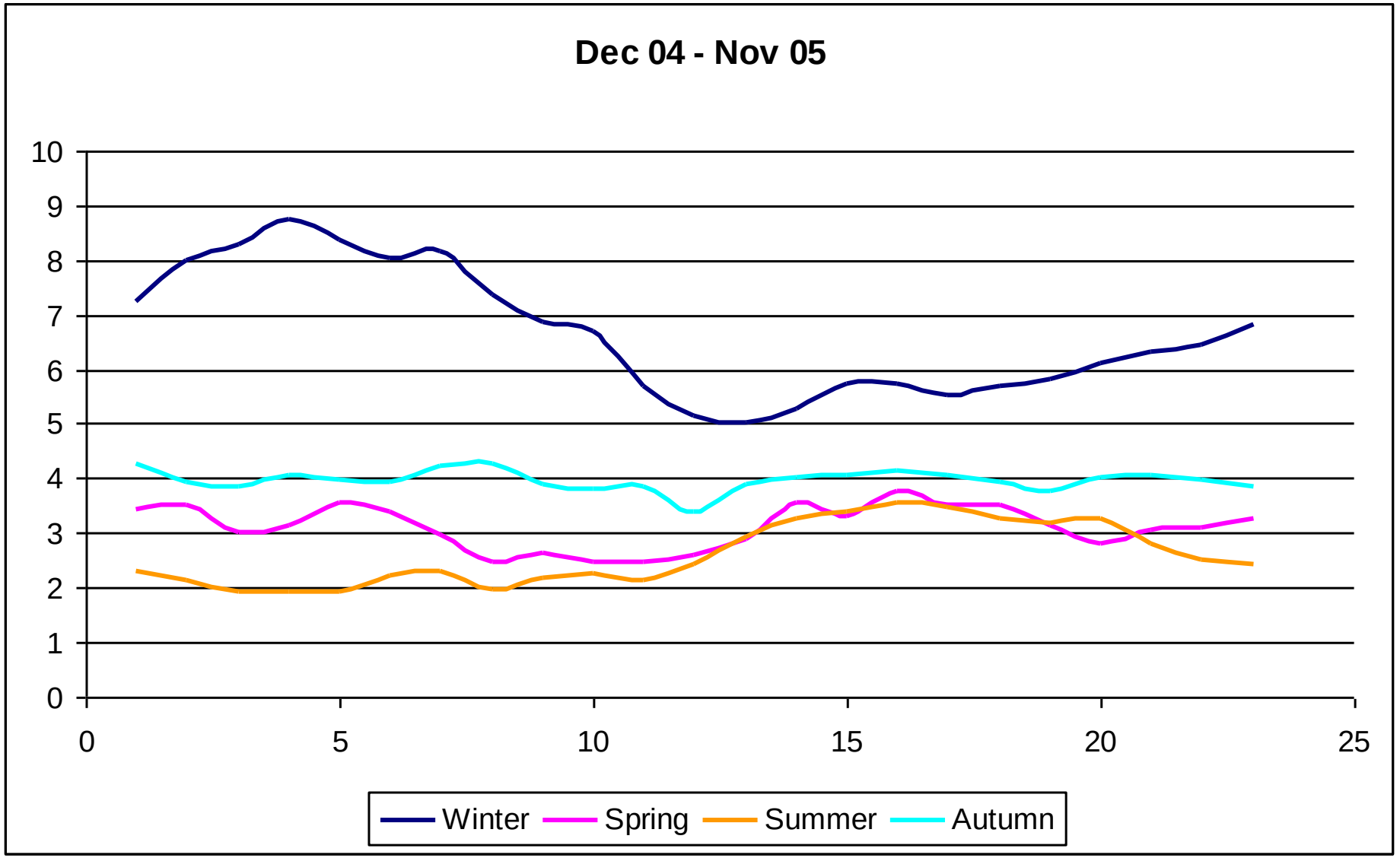
RGM / Ozone / SO_2



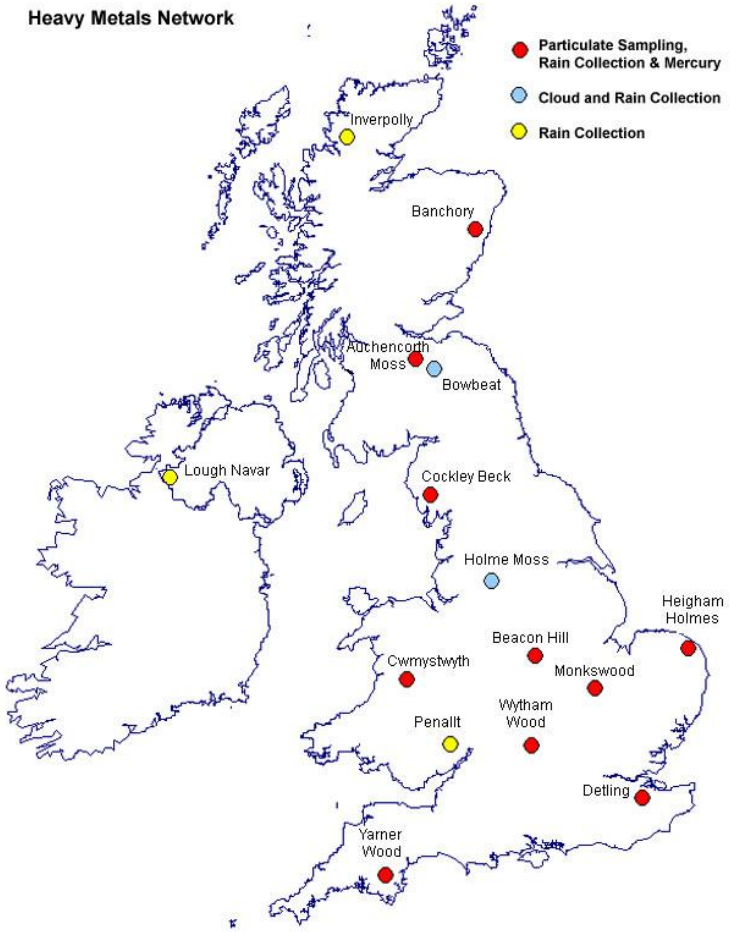
Hg^P


140
120
100
80
60
40
20
0
Conc. HgP (pg/m3)
01/10/04
19/04/05
05/11/05
24/05/06
10/12/06
28/06/07
14/01/08
01/08/08

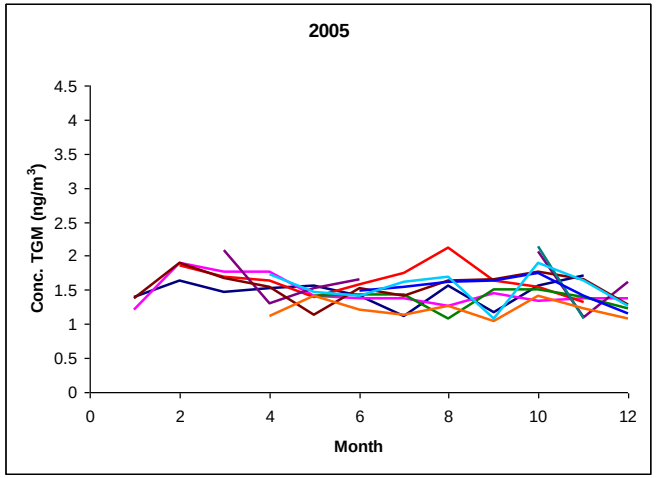
Hg^P

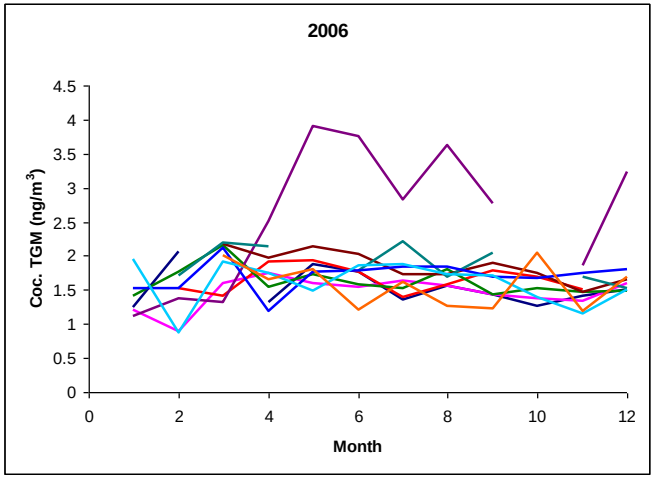

Dec 04 - Nov 05
10
9
8
7
6
5
4
3
2
1
0
0
5
10
15
20
25
Winter
Spring
Summer
Autumn

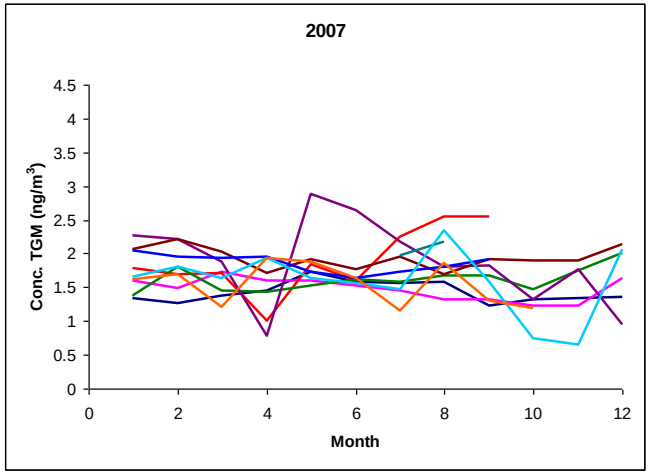
Integrated sampling



Trends?

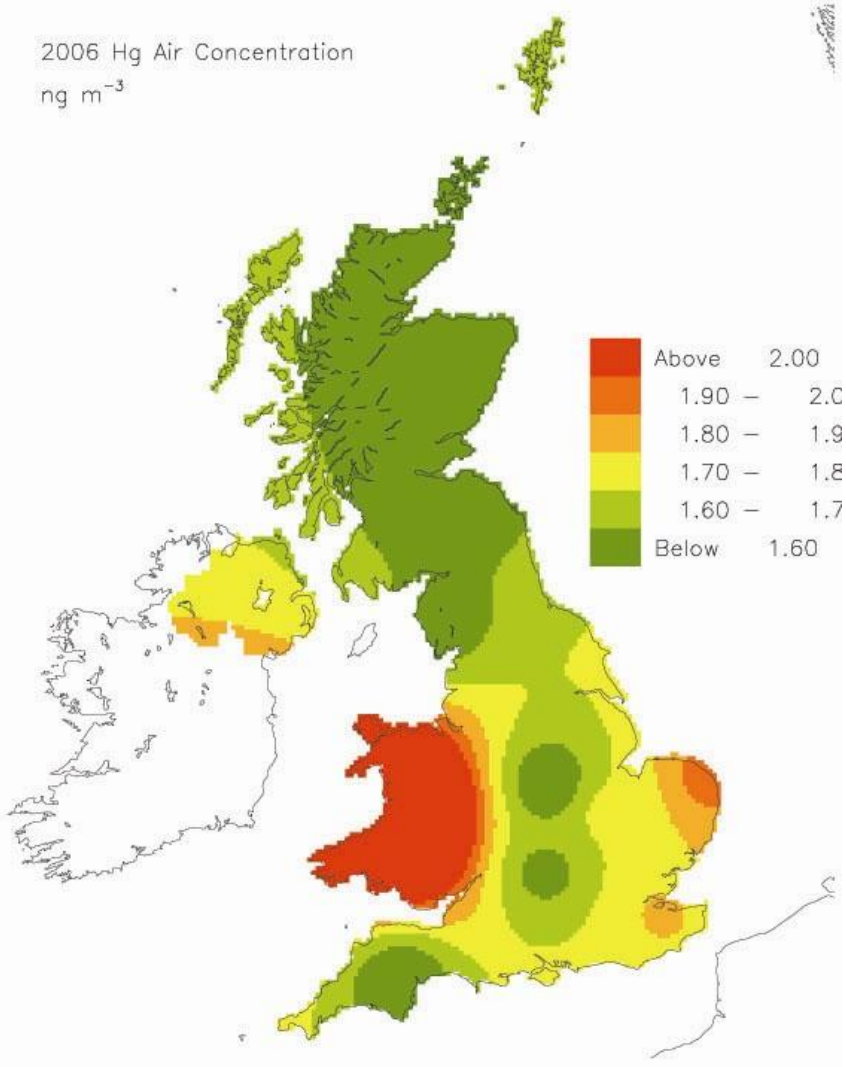

2005
Conc. TGM (ng/m3)
Month
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
0
2
4
6
8
10
12

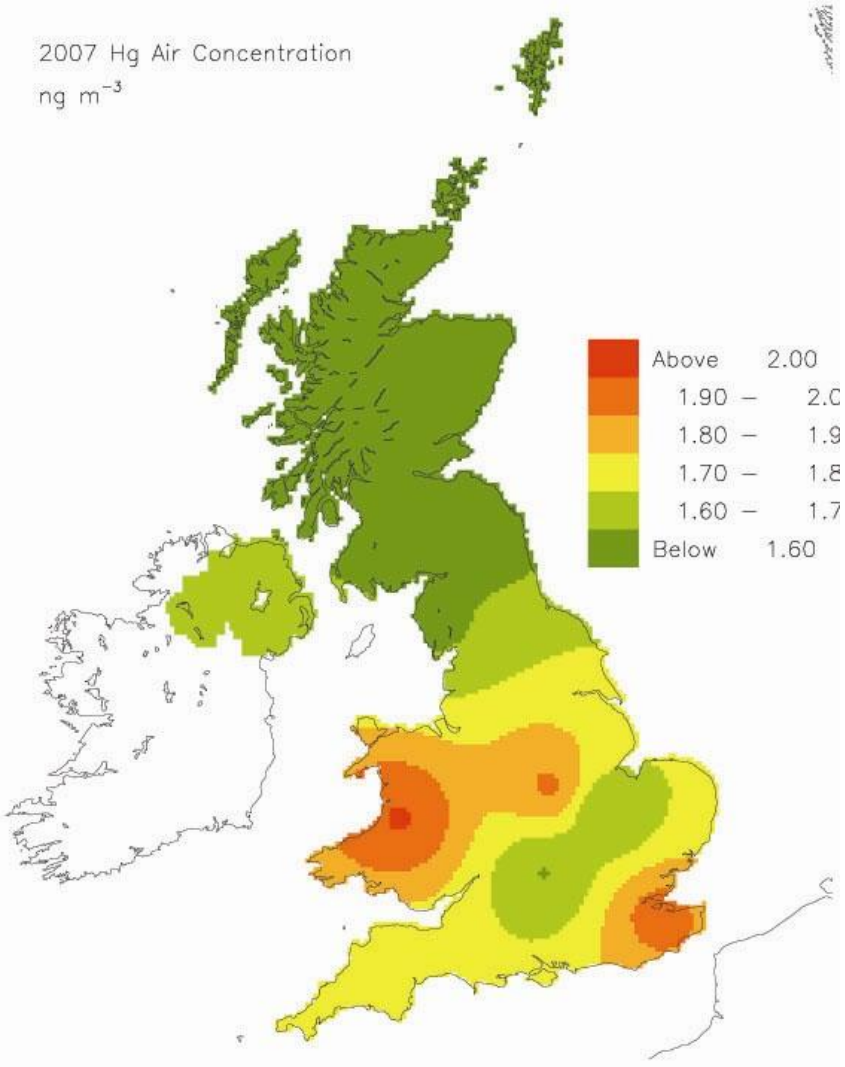

2006
Coc. TGM (ng/m3)
Month
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
0
2
4
6
8
10
12


2007
Conc. TGM (ng/m3)
Month
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
0
2
4
6
8
10
12


Auchencorth
Banchory
Beacon Hill
Cockley Beck
Cwmystwyth
Detling
Heigham Holmes
Monks Wood
Wytham Wood
Yarner Wood

Concentration Maps





Conclusions

- Elemental mercury
  - Background concentration of about 1.5ng/m^3.
  - Use air mass back trajectories to identify peaks and troughs in levels.
- RGM
  - Seasonal variability / diurnal cycle.
  - Dependent to some degree on Ozone conc. as a sign of air mass movements.
- HgP
  - Less clear seasonal / diurnal variability.
- Integrated monitoring
  - Similar levels across sites
  - Little seasonal variation
  - Dramatic effects of local point sources.
- Outcomes
  - Allows for the study of mercury's behaviour in the atmosphere.
  - Helps to monitor the changing nature and impact of global mercury emissions on background mercury levels.
  - Can contributes to the formulation of international agreements on mercury regulation.