

# REPORT

## **Ratification of data produced by the UK Ambient Hydrocarbon Automatic Air Quality Network, 1 October 2002 to 31 December 2002**

A report produced for the Department for Environment, Food and Rural Affairs, the Scottish Executive, the Welsh Assembly Government and the Department of the Environment in Northern Ireland

AEAT/ENV/R/1443 Issue 1  
April 2003



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### **APPENDIX 1 - Summary Statistical Information**

### **APPENDIX 2 - Time Series Plots of Hydrocarbon Concentrations**

# 1 Introduction

This report contains information on the quality and statistical parameters associated with ratified data from the UK Ambient Hydrocarbon Automatic Air Quality Network (The UK Hydrocarbon Network). The presented information and data cover the period 1 October 2002 to 31 December 2002. The ratified data have been made available on the World Wide Web at [http://www.airquality.co.uk/archive/data\\_and\\_statistics\\_home.php](http://www.airquality.co.uk/archive/data_and_statistics_home.php)

This report contains:

- The definition of a Data Quality Code for each reported hydrocarbon.
- The Data Quality Codes assigned to the data presented on the web.
- A list of periods of data loss, reasons for data loss and descriptions of the most significant causes of data loss.
- Statistical information for each measured hydrocarbon for each individual month.

In this report the unit used for expressing concentrations of gases is micrograms per cubic metre ( $\mu\text{g}/\text{m}^3$ ), where previous reports have used parts per billion (ppb). This allows comparison to the relevant Air Quality Standards that are now expressed in micrograms per cubic metre ( $\mu\text{g}/\text{m}^3$ ).

It should be noted that the hydrocarbon instrumentation at the Glasgow site samples air through a separate inlet from that used for the inorganic measurements. The inlet for the inorganic measurements is within one metre from the kerb and hence these are classed as kerbside measurements. The sample inlet for the hydrocarbon measurements is more than one metre from the kerb (but less than five metres) and hence these are classed as roadside measurements.

## 2 Hydrocarbon Data Quality

All hydrocarbon data are assigned a quality value. In general ratified hourly data have an uncertainty (at 95% confidence) of  $\pm 10\%$  for values above  $0.5 \mu\text{g}/\text{m}^3$  and  $\pm 0.05 \mu\text{g}/\text{m}^3$  for values below  $0.5 \mu\text{g}/\text{m}^3$ . These data are termed 'good quality'.

In some cases, because of instrument problems, data cannot be described as 'good' quality, but the data may still be of use to modellers and is therefore included in the archive. This is termed 'acceptable' quality data, and has an uncertainty (at 95% confidence) of  $\pm 25\%$  above  $0.5 \mu\text{g}/\text{m}^3$  and  $\pm 0.1 \mu\text{g}/\text{m}^3$  below  $0.5 \mu\text{g}/\text{m}^3$ .

Data that do not meet either the 'good' or 'acceptable' criteria do not appear in the archive.

Each month's data are assigned a Data Quality Code for each species as follows:

- A. all 'good' quality data
- B. most ( $> 75\%$ ) data points 'good', remainder 'acceptable' quality
- C. roughly equal numbers of 'good' and 'acceptable' quality data
- D. some ( $< 25\%$ ) data points 'good' quality; remainder 'acceptable' quality
- E. all points 'acceptable' quality



# 3 Monthly Data Reports

The following sections give details of issues affecting data on a month by month basis. Data quality codes have been assigned for each monthly set of data.

## 3.1 CARDIFF

### 3.1.1 October

#### 3.1.1.1 Data Quality Codes

Data quality code A for all data for all of the month.

#### 3.1.1.2 Missing Data – All hydrocarbons

- GC circuit board fault from previous quarter 01/10/02 hour 01 to 22/10/02 hour 09.
- Calibration 22/10/02 hours 10 to 12.

#### 3.1.1.3 Missing Data – Specific hydrocarbons

None, except where the integration was unreliable due to very low concentrations.

### 3.1.2 November

#### 3.1.2.1 Data Quality Codes

Data quality code A for all data for all of the month.

#### 3.1.2.2 Missing Data - All hydrocarbons

- Calibration 06/11/02 hours 13 to 15.
- Calibration 21/11/02 hours 12 to 13.
- PC/GC communication problem 22/11/02 hours 08 to 09.
- Calibration 29/11/02 hours 12 to 14.

#### 3.1.2.3 Missing Data - Specific hydrocarbons

None, except where the integration was unreliable due to very low concentrations.

### 3.1.3 December

#### 3.1.3.1 Data Quality Codes

Data quality code A for all data for all of the month.

#### 3.1.3.2 Missing Data - All hydrocarbons

- CMCU visit to change PID lamp 06/12/02 hours 12 to 17.
- Calibration 12/12/02 hours 10 to 12.
- Calibration 23/12/02 hours 09 to 11.

#### 3.1.3.3 Missing Data - Specific hydrocarbons

None, except where the integration was unreliable due to very low concentrations.

## 3.2 GLASGOW

### 3.2.1 October

#### 3.2.1.1 Data Quality Codes

Data quality code A for all data for all of the month except:  
Data quality code B for toluene and (m+p)-xylene for all of the month.

#### 3.2.1.2 Missing Data - All hydrocarbons

- Calibration 08/10/02 hours 12 to 15.
- Calibration 22/10/02 hours 13 to 15.
- PC/GC communication problem 25/10/02 hour 02 to 28/10/02 hour 09.

#### 3.2.1.3 Missing Data - Specific hydrocarbons

None.

### 3.2.2 November

#### 3.2.2.1 Data Quality Codes

Data quality code A for all data for all of the month except:  
Data quality code B for toluene for all of the month.

#### 3.2.2.2 Missing Data - All hydrocarbons

- Calibration 05/11/02 hours 12 to 15.
- Calibration 19/11/02 hours 13 to 15.
- PC/GC communication problem 19/11/02 hour 16 to 20/11/02 hour 13.

#### 3.2.2.3 Missing Data - Specific hydrocarbons

None.

### 3.2.3 December

#### 3.2.3.1 Data Quality Codes

Data quality code A for all data for all of the month except:  
Data quality code B for benzene, toluene and (m+p)-xylene for all of the month.

#### 3.2.3.2 Missing Data - All hydrocarbons

- Calibration 03/12/02 hours 12 to 14.
- PC/GC communication problem 05/12/02 hours 04 to 11.
- Calibration 17/12/02 hours 12 to 17.
- Calibration 30/12/02 hours 12 to 16.

#### 3.2.3.3 Missing Data - Specific hydrocarbons

None.

## 3.3 HARWELL

### 3.3.1 October

#### 3.3.1.1 Data Quality Codes

Data quality code A for all data for all of the month.

#### 3.3.1.2 Missing Data - All hydrocarbons

- Power supply fault 02/10/02 hours 08 to 13.
- Calibration 04/10/02 hours 10 to 12.
- Calibration 10/10/02 hours 14 to 15.
- Calibration 21/10/02 hour 14 to 22/10/02 hour 05.
- Analyser removed to Cardiff. Awaiting repaired analyser 22/10/02 hour 06 to 31/10/02 hour 24.

#### 3.3.1.3 Missing Data - Specific hydrocarbons

None, except where the integration was unreliable due to very low concentrations.

### 3.3.2 November

#### 3.3.2.1 Data Quality Codes

Data quality code A for all data for all of the month.

#### 3.3.2.2 Missing Data - All hydrocarbons

- Analyser removed to Cardiff. Awaiting repaired analyser 01/11/02 hour 01 to 22/11/02 hour 23.
- Calibration 26/11/02 hours 11 to 13.

#### 3.3.2.3 Missing Data - Specific hydrocarbons

None, except where the integration was unreliable due to very low concentrations.

### 3.3.3 December

#### 3.3.3.1 Data Quality Codes

Data quality code A for all data for all of the month.

#### 3.3.3.2 Missing Data - All hydrocarbons

- Calibration 04/12/02 hours 17 to 19.
- Calibration 19/12/02 hours 10 to 13.
- Calibration 24/12/02 hours 10 to 13.

#### 3.3.3.3 Missing Data - Specific hydrocarbons

None, except where the integration was unreliable due to very low concentrations.

## 3.4 MARYLEBONE ROAD

### 3.4.1 October

#### 3.4.1.1 Data Quality Codes

Data quality code A for all data for all of the month.

#### 3.4.1.2 Missing Data - All hydrocarbons

- Calibration 10/10/02 hours 05 to 08.
- Calibration 16/10/02 hours 17 to 20.
- Calibration 31/10/02 hours 10 to 13.

#### 3.4.1.3 Missing Data - Specific hydrocarbons

None.

### 3.4.2 November

#### 3.4.2.1 Data Quality Codes

Data quality code A for all data for all of the month.

#### 3.4.2.2 Missing Data - All hydrocarbons

- Calibration 06/11/02 hours 17 to 20.
- Calibration 15/11/02 hours 04 to 07.
- PC/GC communication problem 16/11/02 hour 24.
- PC/GC communication problem 17/11/02 hours 2, 4, 7, 8, 11, 13, 14, 22 and 24.
- PC/GC communication problem 18/11/02 hours 3, 4 and 6.
- Calibration 21/11/02 hours 10 to 13.
- Service visit 26/11/02 hour 11 to 27/11/02 hour 15.
- Calibration 27/11/02 hours 18 to 21.

#### 3.4.2.3 Missing Data - Specific hydrocarbons

None.

### 3.4.3 December

#### 3.4.3.1 Data Quality Codes

Data quality code A for all data for all of the month.

#### 3.4.3.2 Missing Data - All hydrocarbons

- Calibration 12/12/02 hours 15 to 18.
- Calibration 30/12/02 hours 15 to 18.

#### 3.4.3.3 Missing Data - Specific hydrocarbons

None.

# 4 Discussion

## 4.1 THE RATIFIED DATA

Tables 1 to 4, Appendix 1 contain statistical information relating to the ratified data, for each measured hydrocarbon, over the period 1 October 2002 to 31 December 2002. The tables list the percentage data capture, maximum concentration, mean concentration and minimum concentration of each hydrocarbon. The data capture is the number of ratified hourly data values expressed as a percentage of the number of hours in the specified period.

### 4.1.1 Cardiff

For the Cardiff site the data capture for Benzene was 68.61% and for 1,3-Butadiene was 68.70%. On the 20<sup>th</sup> September, in the previous quarter, a fault developed on the circuit board that controlled the PID heater. It was not possible to repair this at the site or at the CMCU so the analyser was returned to the manufacturer.

This resulted in no data from the 20<sup>th</sup> September to the end of the last quarter and continued into this quarter. On the 22<sup>nd</sup> October the Harwell analyser was moved and installed at Cardiff to prevent further data loss.

Since the installation of the Harwell analyser an instability of the retention times of the peaks has been noticed. However the use of Matchfinder pattern recognition software has ensured that no data has been lost.

### 4.1.2 Glasgow

For the Glasgow site the data capture for Benzene was 93.75% and for 1,3-Butadiene was 93.75%. It was observed that during periods of high concentrations, the peaks on the chromatograms were truncated. As a result the concentrations will be underestimated. It is difficult to quantify the magnitude of the truncation therefore, some compounds have been given lower data quality codes.

- 1,3-Butadiene was not affected by this problem and has been given data quality code A for the whole period.
- Benzene was not affected during October and November and has been assigned data quality code A for these months. During December approximately 4% of the data has been affected therefore data quality code B has been assigned.
- Toluene has been affected for all three months, approximately 10% of the data each month, and has been assigned data quality code B for the whole period.
- (m+p)-Xylene has been assigned data quality code B for October (3% affected), data quality code A for November (not affected) and data quality code B for December (5% affected).
- Ethylbenzene and o-xylene have not been affected by this problem and have been given data quality code A for the whole period.

At the time of writing this report a solution for this problem is being tested.

### 4.1.3 Harwell

For the Harwell site the data capture for Benzene was 63.63% and for 1,3-Butadiene was 63.63%. On the 22<sup>nd</sup> October the analyser installed at the Harwell site was moved and installed at Cardiff to prevent further data loss at the Cardiff site. The faulty analyser, previously installed at the Cardiff site, was returned to the CMCU on 22<sup>nd</sup> November when it was installed at the Harwell site. There have been no other significant problems for the period covered by this report.

### 4.1.4 Marylebone Road

For the Marylebone Road site the data capture for Benzene was 94.84% and for 1,3-Butadiene was 95.70%. There were no significant problems for the period covered by this report.

## 4.2 CONCENTRATION TRENDS

The periods when data for benzene and 1,3-butadiene were available, for all the sites, are plotted graphically in Figures 1 to 8, Appendix 2. The measured concentrations of 1,3-Butadiene fell below  $0.02 \mu\text{g}/\text{m}^3$  on a number of occasions see figures 2 and 6, Appendix 2. Where concentrations fell below  $0.02 \mu\text{g}/\text{m}^3$  the ratified concentrations have been reported as  $0.00 \mu\text{g}/\text{m}^3$ .

At Cardiff and Harwell the measured concentrations of hydrocarbons were low for most of the period covered by this report. There was one episode of elevated concentrations during December probably due to meteorological conditions. At these urban background and rural sites there tends to be a pattern of seasonal variation with higher levels during the winter when dispersion is generally poorer and photochemical removal is at a minimum.

The Glasgow and Marylebone Road data tend to exhibit higher levels with less seasonal variation than is apparent in data from the other two sites. The measured concentrations and trends are typical of sites close to busy roads where the source of the measured hydrocarbons is close to the monitoring location. The emitted hydrocarbons will have had little time to mix and react in the atmosphere. The measured concentrations at Glasgow for October to December 2002 exhibited one episode of elevated concentrations during December probably due to meteorological conditions. The measured concentrations at Marylebone Road for October to December 2002 exhibited no significant episodes of elevated concentrations. There is insufficient information to provide an explanation of the observed difference in the trends from site to site, although spatial variations in meteorological conditions may well be the cause. The time series for reported concentrations of nitrogen oxides (NO<sub>x</sub>) exhibited a high degree of similarity to the time series for reported hydrocarbons at each of the sites. The variation in trends from site to site is probably due to variations in atmospheric dispersion.

## 4.3 COMPARISON WITH AIR QUALITY OBJECTIVES

The Air Quality Strategy for the UK has set Air Quality Objectives for benzene and 1,3-butadiene. The Air Quality Objective for benzene in the UK is  $16.25 \mu\text{g}/\text{m}^3$  expressed as a running annual mean to be met by 31 December 2003. In England and Wales there is an additional objective for benzene of  $5 \mu\text{g}/\text{m}^3$  expressed as an annual mean to be met by end of 2010. In Scotland an additional objective has been set for benzene of  $3.25 \mu\text{g}/\text{m}^3$  to be met by the end of 2010. The Air Quality Objective for 1,3-butadiene is specified as a running annual mean of  $2.25 \mu\text{g}/\text{m}^3$  to be met by the end of 2003.

The annual means for benzene and 1,3-butadiene for 2000, 2001 and 2002 together with the quarterly means for the four quarters of 2002 are given in Tables 1 and 2 below. For benzene the annual means for 2000, 2001 and 2002 were well below the respective Air Quality Objective of  $16.25 \mu\text{g}/\text{m}^3$  to be met by the end of 2003. The annual means for 2001 were also below the Air Quality Objective to be met by 2010 for the respective region.

The means for both benzene and 1,3-butadiene for quarter 1, 2002 were slightly lower than the annual means for 2001. The means for quarter 2, 2002 were significantly lower than the means for quarter 1, 2002 and annual means for 2000 and 2001. The means for quarter 3, 2002 are very similar to those of quarter 2, 2002. The means for quarter 4, 2002 show an increase over quarter 3, 2002. This is probably due to seasonal variation and an episode of elevated concentrations during December.

Table 1. Means of measured Benzene Concentrations ( $\mu\text{g}/\text{m}^3$ ) at each of the UK Automatic Hydrocarbon Sites.

Monitoring Site	2000 Annual Mean	2001 Annual Mean	2002 Annual Mean	Quarter 1 2002 Mean	Quarter 2 2002 Mean	Quarter 3 2002 Mean	Quarter 4 2002 Mean
Cardiff	1.68	1.75	0.83	1.01	0.58	0.49	1.43
Edinburgh	1.17	1.33	0.77 \$	0.88	0.58	\$\$	\$\$
Glasgow	\$\$	\$\$	2.33 \$	\$\$	\$\$	1.95	2.63
Harwell	0.53	0.62	0.60	0.68	0.39	0.39	1.14
Marylebone Road	6.29	4.55	3.91	4.64	3.31	3.47	4.25

\$ Annual means calculated from significantly less than 12 months data

\$\$ The Edinburgh instrument was relocated to the Glasgow site.

Table 2. Means of measured 1,3-Butadiene Concentrations ( $\mu\text{g}/\text{m}^3$ ) at each of the UK Automatic Hydrocarbon Sites.

Monitoring Site	2000 Annual Mean	2001 Annual Mean	2002 Annual Mean	Quarter 1 2002 Mean	Quarter 2 2002 Mean	Quarter 3 2002 Mean	Quarter 4 2002 Mean
Cardiff	0.29	0.27	0.08	0.09	0.04	0.04	0.18
Edinburgh	0.14	0.20	0.05	0.07	0.04	\$\$	\$\$
Glasgow	\$\$	\$\$	0.36	\$\$	\$\$	0.40	0.34
Harwell	0.09	0.11	0.04	0.04	0.02	0.02	0.11
Marylebone Road	1.63	1.12	0.95	1.15	0.88	0.83	0.94

\$ Annual means calculated from significantly less than 12 months data

\$\$ The Edinburgh instrument was relocated to the Glasgow site.

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# Appendix 1

## Summary Statistical Information

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- Table 2. Percentage data capture, maximum, mean and minimum values of ratified data from the Glasgow site of the UK Hydrocarbon Network, for the period; 1 October 2002 to 31 December 2002
- Table 3. Percentage data capture, maximum, mean and minimum values of ratified data from the Harwell site of the UK Hydrocarbon Network, for the period; 1 October 2002 to 31 December 2002
- Table 4. Percentage data capture, maximum, mean and minimum values of ratified data from the Marylebone Road site affiliated to the UK Hydrocarbon Network, for the period; 1 October 2002 to 31 December 2002

Table 1. Percentage data capture, maximum, mean and minimum values of the ratified data from the Cardiff site of the UK Hydrocarbon Network, for the period 1 October 2002 to 31 December 2002

Compound	%Data capture	Maximum concentration ( $\mu\text{g}/\text{m}^3$ )	Mean concentration ( $\mu\text{g}/\text{m}^3$ )	Minimum concentration ( $\mu\text{g}/\text{m}^3$ )
1,3-Butadiene	68.70	4.29	0.18	0.00
Benzene	68.61	5.68	1.43	0.00
Toluene	74.50	49.38	4.51	0.27
Ethylbenzene	48.96	5.29	0.93	0.04
(m+p)-Xylene *	66.35	17.89	2.78	0.09
o-Xylene	53.80	11.94	1.41	0.04

\* (m+p)-Xylene data are reported as the sum of the 2 individual components due to the fact that they are not sufficiently well resolved in the chromatogram.

Table 2. Percentage data capture maximum, mean and minimum values of ratified data from the Glasgow site of the UK Hydrocarbon Network, for the period 1 October 2002 to 31 December 2002

Compound	%data capture	Maximum concentration ( $\mu\text{g}/\text{m}^3$ )	Mean concentration ( $\mu\text{g}/\text{m}^3$ )	Minimum concentration ( $\mu\text{g}/\text{m}^3$ )
1,3-Butadiene	93.75	2.60	0.34	0.00
Benzene	93.75	18.13	2.63	0.06
Toluene	93.66	30.45	8.95	0.11
Ethylbenzene	93.75	18.11	1.81	0.04
(m+p)-Xylene *	93.57	28.78	5.86	0.18
o-Xylene	93.75	23.53	2.64	0.04

\* (m+p)-Xylene data are reported as the sum of the 2 individual components due to the fact that they are not sufficiently well resolved in the chromatogram.

Table 3. Percentage data capture, maximum, mean and minimum values of ratified data from the Harwell site of the UK Hydrocarbon Network, for the period; 1 October 2002 to 31 December 2002

Compound	%data capture	Maximum concentration ( $\mu\text{g}/\text{m}^3$ )	Mean concentration ( $\mu\text{g}/\text{m}^3$ )	Minimum concentration ( $\mu\text{g}/\text{m}^3$ )
1,3-Butadiene	63.63	1.28	0.11	0.00
Benzene	63.63	8.72	1.14	0.19
Toluene	63.59	30.37	2.52	0.15
Ethylbenzene	52.04	5.82	0.53	0.04
(m+p)-Xylene *	62.14	18.51	1.37	0.09
o-Xylene	54.62	8.68	0.71	0.04

\* (m+p)-Xylene data are reported as the sum of the 2 individual components due to the fact that they are not sufficiently well resolved in the chromatogram.

Table 4. Percentage data capture, maximum, mean and minimum values of ratified data from the Marylebone Road site affiliated to the UK Hydrocarbon Network for the period; 1 October 2002 to 31 December 2002

Compound	%data capture	Maximum concentration ( $\mu\text{g}/\text{m}^3$ )	Mean concentration ( $\mu\text{g}/\text{m}^3$ )	Minimum concentration ( $\mu\text{g}/\text{m}^3$ )
Ethane	95.70	107.93	11.99	2.99
Ethene	95.70	29.13	7.88	0.57
Propane	95.70	56.53	7.15	1.43
Propene	95.70	16.26	4.00	0.37
Ethyne	95.70	24.87	5.07	0.42
2-Methylpropane	95.70	57.44	9.84	0.82
n-Butane	95.70	78.78	15.60	1.28
trans-2-Butene	95.70	7.57	1.19	0.23
1-Butene	95.70	6.33	1.19	0.07
cis-2-Butene	95.70	5.61	0.86	0.09
2-Methylbutane	95.70	91.00	16.23	0.99
n-Pentane	95.70	20.18	4.07	0.42
1,3-Butadiene	95.70	3.52	0.94	0.07
trans-2-Pentene	95.70	8.53	1.08	0.03
cis-2-Pentene	95.56	4.05	0.58	0.03
2-Methylpentane	95.70	43.59	5.08	0.32
3-Methylpentane	95.70	18.95	3.15	0.21
Isoprene	95.24	2.09	0.45	0.03
n-Hexane	95.61	12.23	1.86	0.18
n-Heptane	95.56	8.19	0.96	0.04
Benzene	94.84	20.53	4.25	0.26
Toluene	95.70	91.73	17.06	0.77
Ethylbenzene	95.47	17.06	3.22	0.04
(m+p)-Xylene *	88.13	61.96	11.90	0.48
o-Xylene	95.52	21.15	3.88	0.09
1,3,5-Trimethylbenzene	95.70	14.22	1.30	0.05
1,2,4-Trimethylbenzene	95.70	28.79	3.94	0.25

\* (m+p)-Xylene are reported as the sum of the 2 individual components due to the fact that they are not sufficiently well resolved in the chromatogram.

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# Appendix 2

## Time Series Plots of Hydrocarbon Concentrations

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- Figure 3. Time series plot of the ratified Benzene data from the Glasgow site of the UK Hydrocarbon Network, for the period; 1 October 2002 to 31 December 2002
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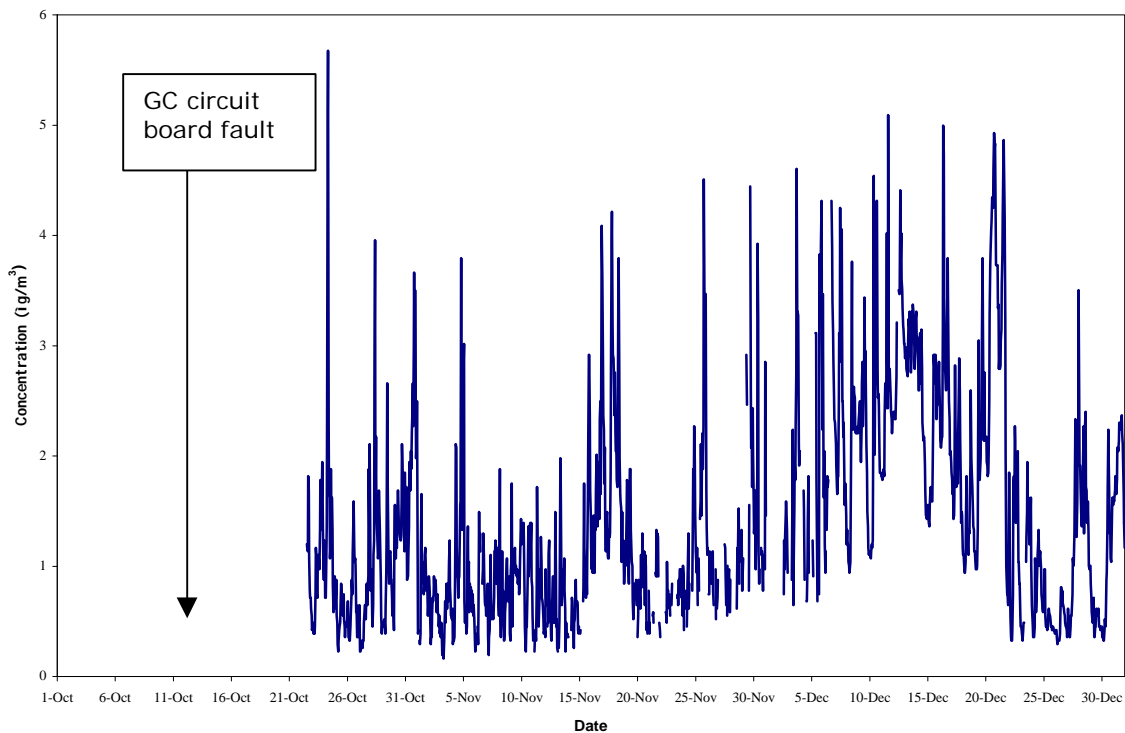


Figure 1. Time series plot of the ratified Benzene data from the Cardiff site of the UK Hydrocarbon Network, for the period; 1 October 2002 to 31 December 2002

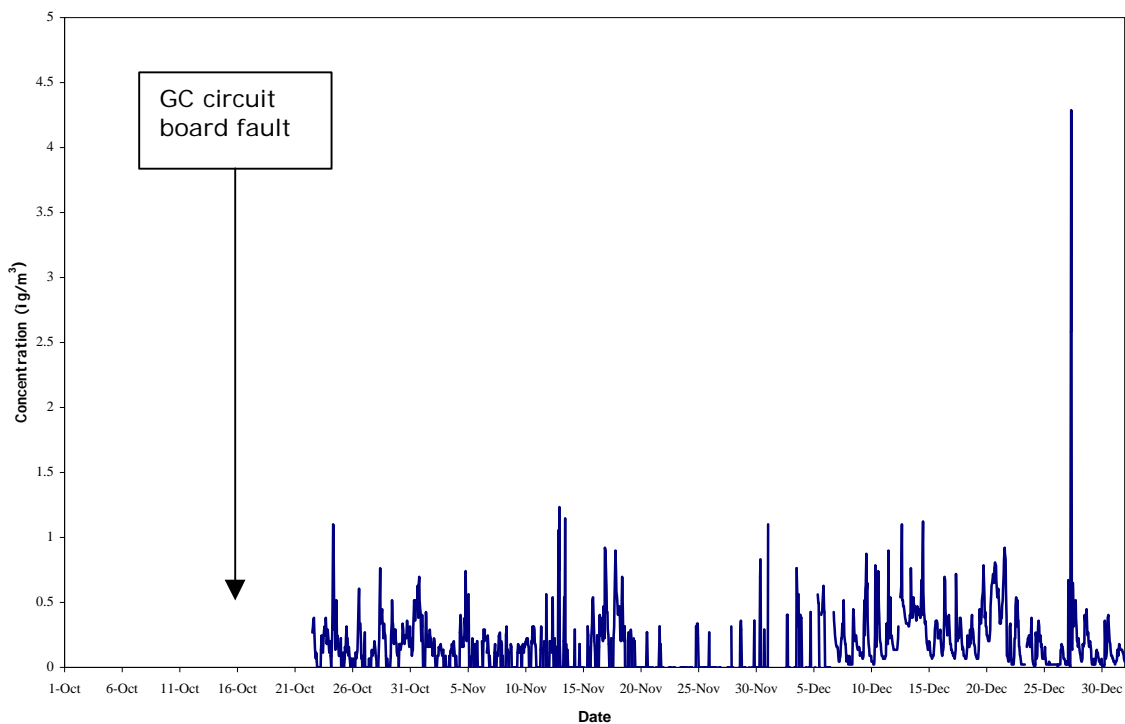


Figure 2. Time series plot of the ratified 1,3-Butadiene data from the Cardiff site of the UK Hydrocarbon Network, for the period; 1 October 2002 to 31 December 2002

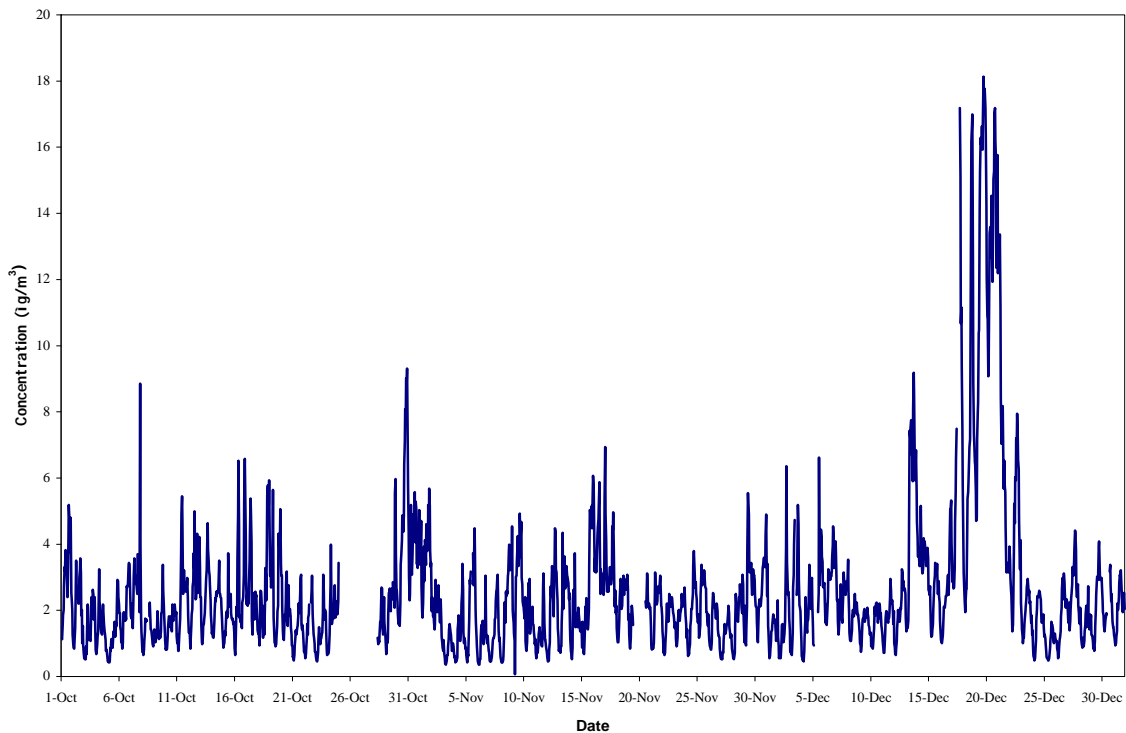


Figure 3. Time series plots for the ratified Benzene data from the Glasgow site of the UK Hydrocarbon Network, for the period; 1 October 2002 to 31 December 2002

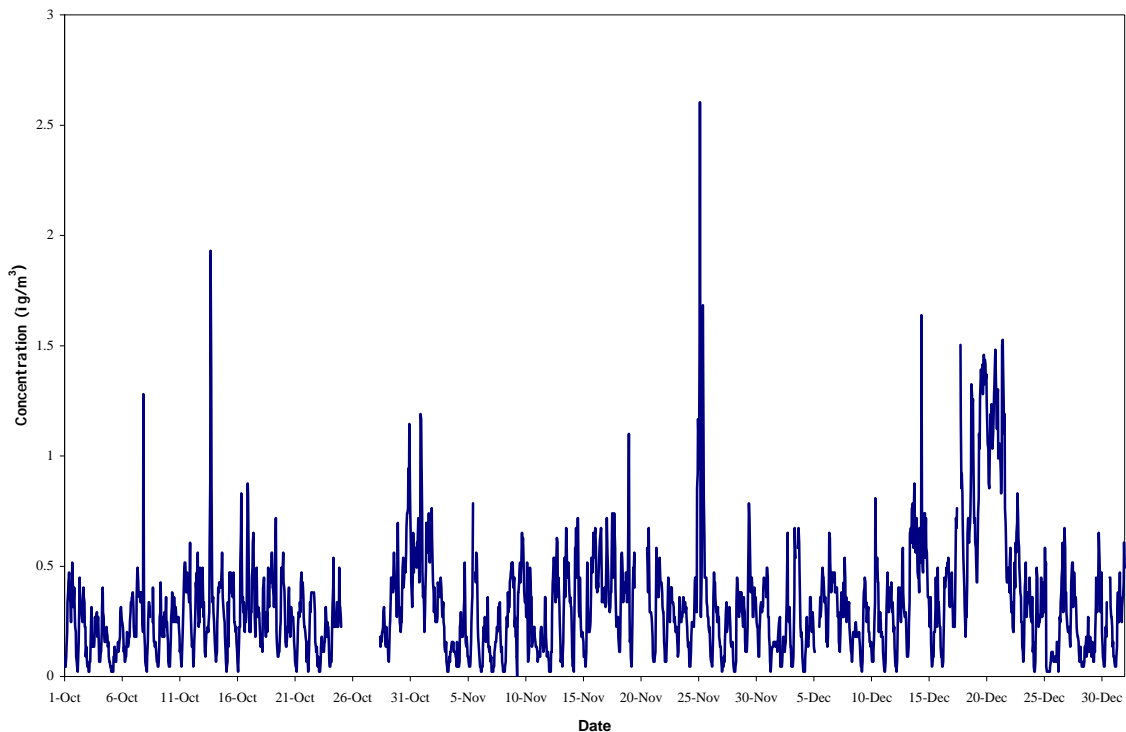


Figure 4. Time series plots for the ratified 1,3-Butadiene data from the Glasgow site of the UK Hydrocarbon Network, for the period; 1 October 2002 to 31 December 2002



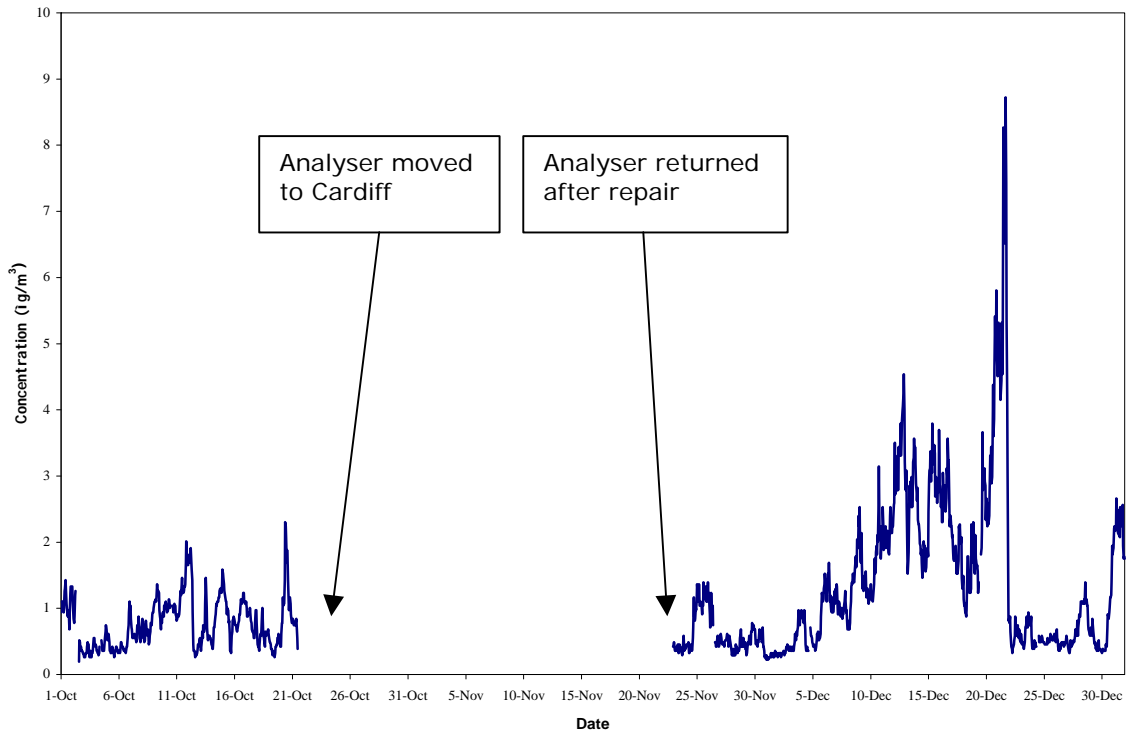


Figure 5. Time series plots for the ratified Benzene data from the Harwell site of the UK Hydrocarbon Network, for the period; 1 October 2002 to 31 December 2002

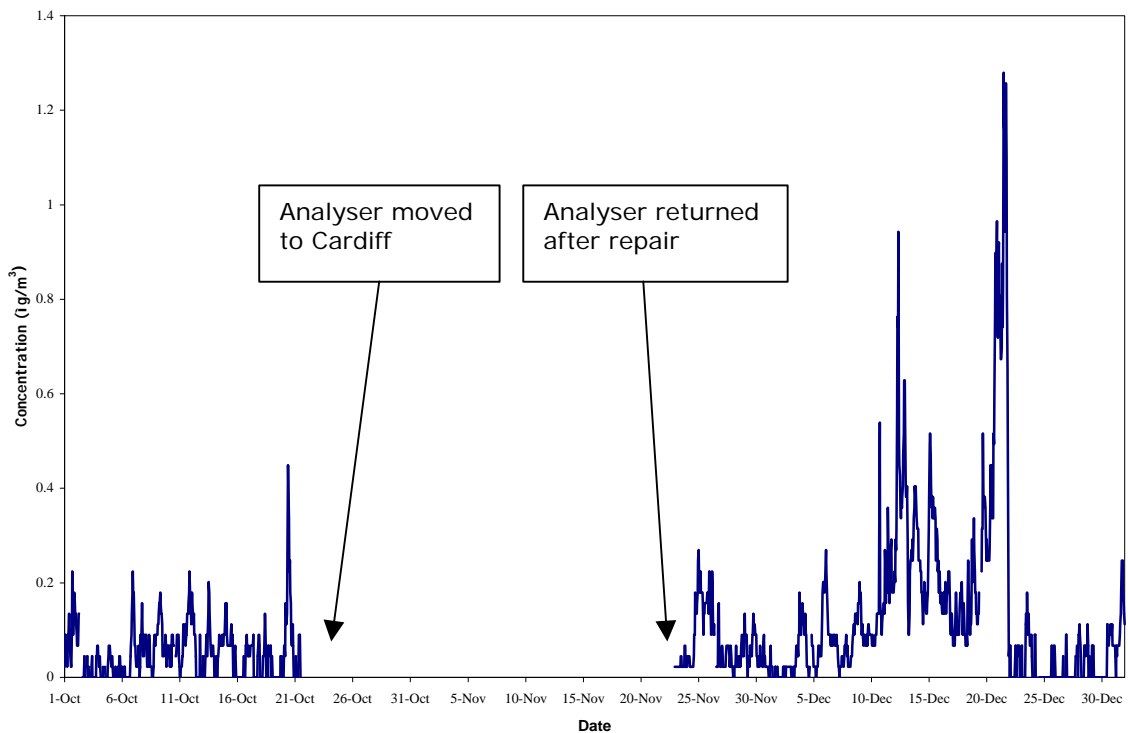


Figure 6. Time series plots for the ratified 1,3-Butadiene data from the Harwell site of The UK Hydrocarbon Network, for the period; 1 October 2002 to 31 December 2002

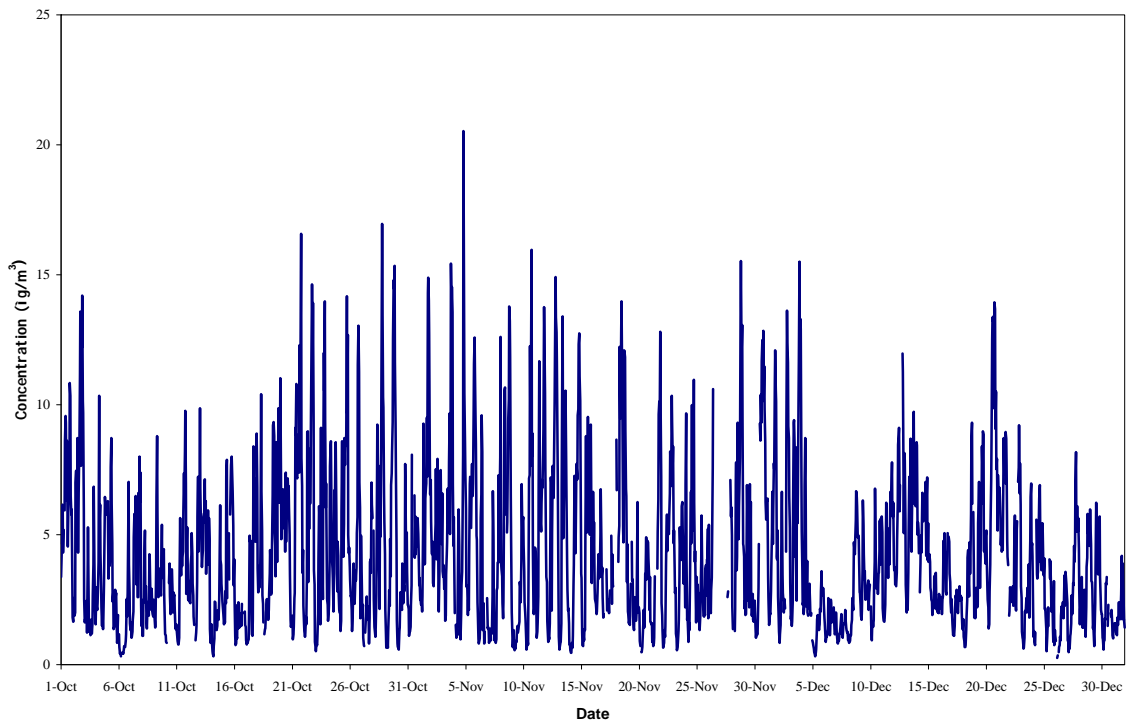


Figure 7. Time series plots for the ratified Benzene data from the Marylebone Road site affiliated to the UK Hydrocarbon Network, for the period; 1 October 2002 to 31 December 2002

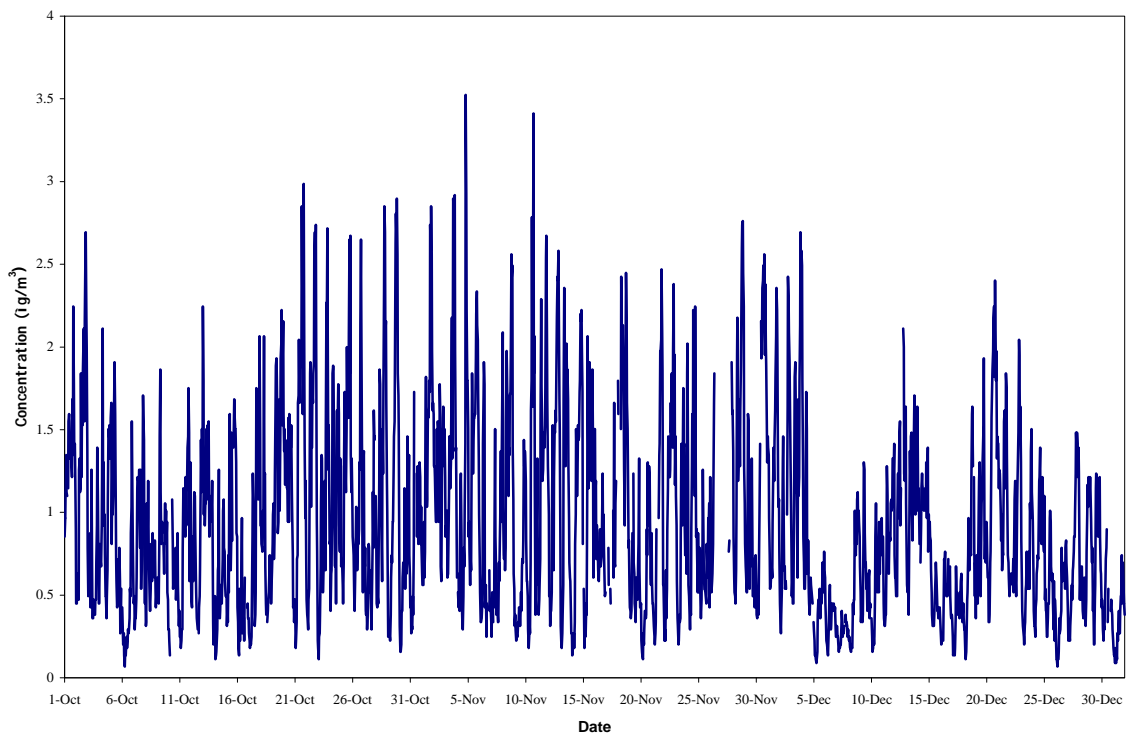


Figure 8. Time series plots for the ratified 1,3-Butadiene data from the Marylebone Road site affiliated to the UK Hydrocarbon Network, for the period; 1 October 2002 to 31 December 2002