

Report

UK Smoke and Sulphur Dioxide Network 2001

Report prepared by **netcen** as part of the Air Quality Research Programme of the Department for Environment, Food and Rural Affairs, Scottish Executive, Welsh Assembly Government and Department of the Environment in Northern Ireland.

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Executive Summary

This report presents the results from the UK Smoke and Sulphur Dioxide Network for the calendar year 1st January to 31st December 2001, providing a summary of data from the 170 sites comprising the Network this year. These data are compared with the standards and objectives specified in the Air Quality Strategy, and with limit and guide values specified in applicable EC Directives on sulphur dioxide and suspended particles. Concentration trends and spatial distributions throughout the UK are also discussed.

UK average concentrations for calendar year 2001, based on 118 "core" sites, were $8.2 \mu\text{g m}^{-3}$ and $14.9 \mu\text{g m}^{-3}$ for smoke and SO_2 respectively. The average smoke concentration is slightly higher than the average reported for calendar year 2000, while the average SO_2 average slightly lower than in 2000. (The 2000 averages were $7.4 \mu\text{g m}^{-3}$ for smoke and $15.4 \mu\text{g m}^{-3}$ for SO_2).

Data for calendar year 2001 were compared with the 1st Daughter Directive (1999/30/EEC) 24-hour limit value for SO_2 (to be met by 1st January 2005), and the identical Air Quality Strategy 24-hour objective, (to be met by 31st December 2004). Four Network sites exceeded the AQS objective of $125 \mu\text{g m}^{-3}$ for 24-hour mean SO_2 on more than the three permitted occasions. These sites were BARNSELEY 8, BELFAST 13, BELFAST 33 and BELFAST 42.

Data for calendar year 2001 were also compared with the Stage 1 limit values and objectives for particulate matter contained in the 1st Daughter Directive and the Air Quality Strategy, (which are to be met by 1st January 2005 and 31st December 2004 respectively). These specifically apply to PM_{10} , not black smoke, and the latest Technical Guidance does not recommend that black smoke data are routinely used to assess compliance with AQS objectives. However, black smoke can be considered a subset of PM_{10} , so if black smoke exceeds an objective it is reasonable to suspect that total PM_{10} has also exceeded. At one site in the Network, the daily mean black smoke concentration exceeded the 24-hour limit of $50 \mu\text{g m}^{-3}$ for PM_{10} on more than the 35 permitted occasions. This site was STRABANE 2, located on a housing estate in Northern Ireland where domestic coal burning is prevalent and dispersion is sometimes poor.

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1 Introduction

This is the annual summary report for the Smoke and Sulphur Dioxide Network, for calendar year 2001. This report presents a description of the Network, and a summary and review of the data for 2001. Results are compared with applicable air quality limit values and objectives. Trends, spatial distribution of smoke and sulphur dioxide concentrations throughout the UK, data reporting commitments and data usage are discussed. The main report is followed by Appendices which provide details of the derivation and calculation of the statistics presented in the report.

2 Network Objectives

The UK Smoke and Sulphur Dioxide (SO₂) Network (Figure 1) serves two purposes. Firstly, to provide a long-term database of smoke and SO₂ measurements, used to assess trends in concentration and spatial distribution. For this purpose, a "core" subset of sites is used to provide a representative sample of monitoring locations in major population centres throughout the UK, with a wide spatial coverage of the whole country. A total of 170 Network sites were in operation during part or all of 2001 (see Figure 1). Of these sites, 118 comprised the "core" subset used to provide national trend statistics (see discussion in Section 4).

Secondly, the Network monitors compliance with relevant air quality limits and guidelines. The original European Council Directive on Sulphur Dioxide and Suspended Particles (80/779/EEC)¹, in force since 1980, is now being superceded. The European Commission issued a Directive on Ambient Air Quality Assessment and Management² - the so-called "Framework Directive" in 1996. Under this framework, a number of "Daughter Directives" covering specific pollutants are being prepared. The first Daughter Directive (1999/30/EEC)³ came into force in July 2001 and includes limit values for SO₂ and particulate matter, to be met by 1 January 2005. The limits for suspended particulate relate to PM₁₀, not black smoke; therefore data from this Network are not directly comparable. However, the existing standards for smoke and SO₂ will remain in force until 2005. Because of the seasonal patterns often exhibited by these pollutants, the annual limits and guide values of Directive 80/779/EEC were based upon a "Pollution Calendar" year, which ran from April to March, thus winters were not split between two years. Comparison of Network data with this Directive is now reported to Defra separately from this report. In formally assessing compliance with applicable air quality limits and objectives, analysis of *all* sites in the Network is undertaken, regardless of whether they are part of the "core" subset.

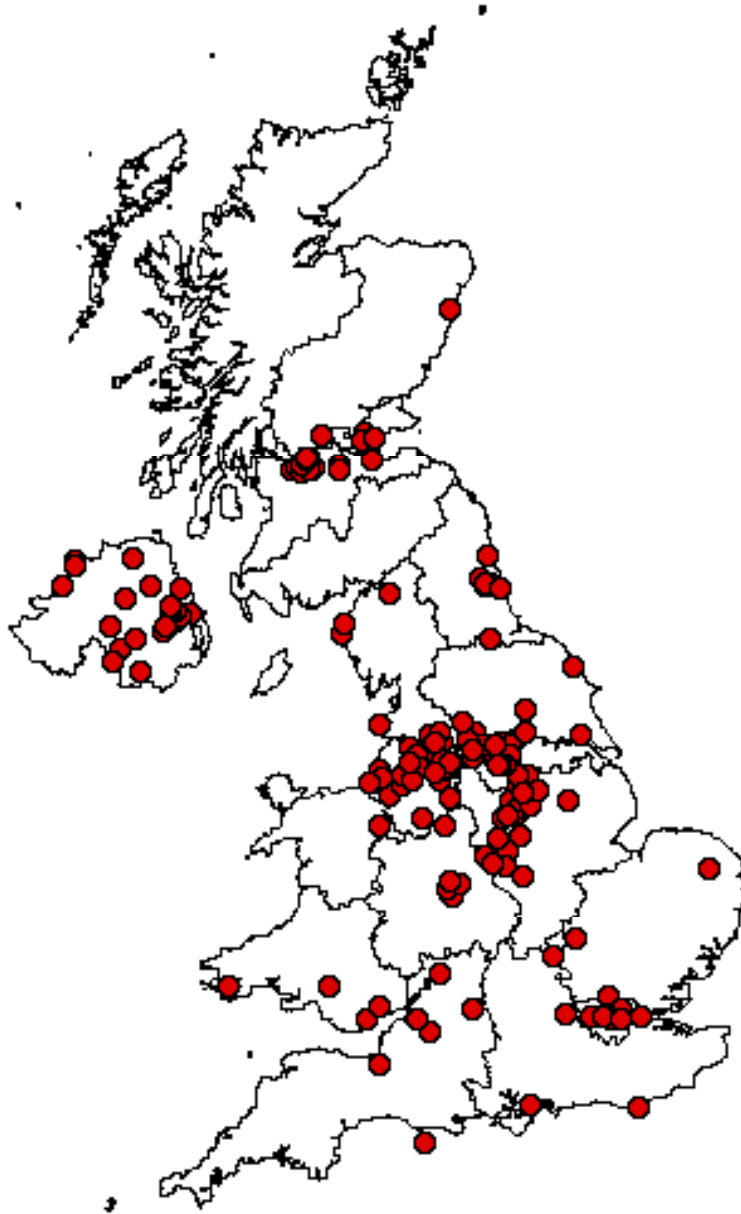


Figure 1. Locations of Smoke and Sulphur Dioxide Network Monitoring Sites

3 Data Reporting and Use

The UK Smoke and SO₂ Network, and its predecessor the National Survey, together provide one of the longest running databases of air quality measurements in the UK, having been in operation as a coordinated national network for over 40 years. The results have shown clearly the dramatic decrease in the concentrations of these pollutants in the UK over this period. With the exception of the UK Nitrogen Dioxide Diffusion Tube Network, the Smoke and SO₂ Network still constitutes the most widespread air quality monitoring programme in the UK.

3.1 STATUTORY REPORTING: EC DIRECTIVE

The UK Smoke and Sulphur Dioxide Network fulfils the statutory monitoring requirements of the EC Directive on Sulphur Dioxide and Suspended Particulates¹, which, as discussed in Section 2, remains in force until fully repealed in 2005. In June and July each year, the data from the previous pollution year (April - March) are analysed with respect to the requirements of the Directive. The results are supplied to the Department for Environment, Food and Rural Affairs (Defra) for formal submission to the European Commission.

3.2 EC EXCHANGE OF INFORMATION

Under the terms of the EC Exchange of Information Decision⁴, the Department for Environment, Food and Rural Affairs has agreed to supply to the Commission, full daily data for all sites in the Network, from 1997 onwards. The data are supplied to the European Topic Centre on Air Quality, for inclusion in their "AIRBASE" database, at <http://www.etcaq.rivm.nl/airbase/index.html>.

3.3 PUBLIC DISSEMINATION

This report provides a major route for public dissemination of data from the Network. However, data are also summarised in the Digest of Environmental Statistics, published annually by the Stationery Office⁵. Also, ad hoc requests for data are serviced by retrievals from the database held at **netcen**. These are normally provided free of charge.

A comprehensive archive of air quality measurements, including data from the Smoke and SO₂ Network, is available on the World Wide Web, via Defra's Air Quality Archive at www.airquality.co.uk. Daily data from 1961 onwards are available, and are updated regularly.

4 Results and Discussion

4.1 METHODS AND UNITS

Both smoke and sulphur dioxide concentrations are expressed in micrograms per cubic metre ($\mu\text{g m}^{-3}$) in this report.

(i) Smoke: in the UK, smoke concentrations are usually calculated according to the British Standard Smoke Stain (BS) Calibration. This report primarily uses the BS calibration, and all black smoke concentrations are in this form except where stated. However, elsewhere in Europe, the Organisation for Economic Co-operation and Development (OECD) Smoke Calibration Curve (OECD Publication no. 17913: 1964) is used. Concentrations given according to the BS calibration can be converted to OECD by dividing by 0.85. In any communication with the European Commission, it is normal to use the OECD calibration. Where OECD smoke concentrations appear in this report, they are indicated as OECD and shown in *italics*.

(ii) SO₂: this network uses the Total Acidity method to determine the total concentration of strong acidic gases in the air; the results are expressed as SO₂ equivalent. The units used in this report for SO₂ are $\mu\text{g m}^{-3}$. However, concentrations of gaseous pollutants are sometimes expressed as parts per billion by volume (abbreviated to "ppb"). For SO₂, the conversion factor used by the EC is as follows: **1 ppb = 2.66 $\mu\text{g m}^{-3}$, at a temperature of 20°C and 1013 mb pressure.** (This **only** applies to SO₂; conversion factors are different for other gaseous pollutants.)

4.2 SUMMARY OF RESULTS

Summary statistics for the year 2001 for each Network site are provided in Table 1. The sites are listed by Government region (Scotland, the North East, North West and Merseyside, Yorkshire and the Humber, East Midlands, West Midlands, Wales, Eastern, London, South East, South West and Northern Ireland). Table 1 is subdivided into 12 separate Tables, 1.1 to 1.12, for the 12 regions. **As Table 1 is large, it has been placed at the end of the text.** Within each region, sites are grouped by the Local or Unitary Authority in whose area they are situated. In most cases, this Authority is responsible for the operation of the site, although a small number are operated by other organisations such as universities.

For sites in England, Wales and Scotland, Table 1 gives the location as an Ordnance Survey grid reference, to the nearest 100m. For sites in Northern Ireland, the Irish Grid is used.

The following abbreviations are used in Table 1:

1. "**Data Capt. %**" is percentage data capture – the number of days in the calendar year for which valid data was obtained, expressed as a percentage.
2. "**Arith. Mean**" is the arithmetic mean of all daily values, calculated by the usual method, as described in Appendix 1.
3. "**Median**" is the median, or 50th percentile, of all daily values. See Appendix 1.
4. "**98th %ile**" is the 98th percentile of all daily values, see Appendix 1.
5. "**Max. Day**" is the maximum daily value measured during the year.

4.3 DATA CAPTURE

The data capture objective specified by Annex IV of the First Daughter Directive (1999/30/EEC) for indicative techniques is 90%; therefore this is the target for minimum data capture in the Network. Only 45% of sites met this target in 2001, and the average data capture for all sites in the Network was 78%. These data capture statistics are slightly lower than those achieved in the previous year.

However, these figures include the 33 sites which began or ceased operation part way through the year, and therefore could not have achieved 90% data capture. If these sites are ignored, 55% of the remainder achieved the target of 90% data capture, and average data capture was 87%: slightly better than last year.

Data capture remains an area where improvement is needed. Reasons given for missing data included equipment problems, lack of access to buildings over holiday periods, and staff or resource shortages. Advice for site operators on dealing with equipment faults and improving data capture are given in the Network's Instruction Manual. Every site operator should have an up-to-date copy of the Manual to hand: it can be downloaded from <http://www.aeat.co.uk/netcen/airqual/reports/smkman/shead.html> ; alternatively printed copies are available from **netcen**. Site operators are welcome to contact **netcen** for advice on any aspect of smoke or SO₂ monitoring.

4.4 UK AVERAGE SMOKE AND SO₂ CONCENTRATIONS

Annual mean UK smoke and SO₂ are estimated on the basis of a "core" subset of sites. There were 118 sites in the "core" subset during 2001. Annual mean concentrations were calculated by averaging the annual means from all core sites, excluding any with data capture of less than 70%, and for 2001 were as follows:

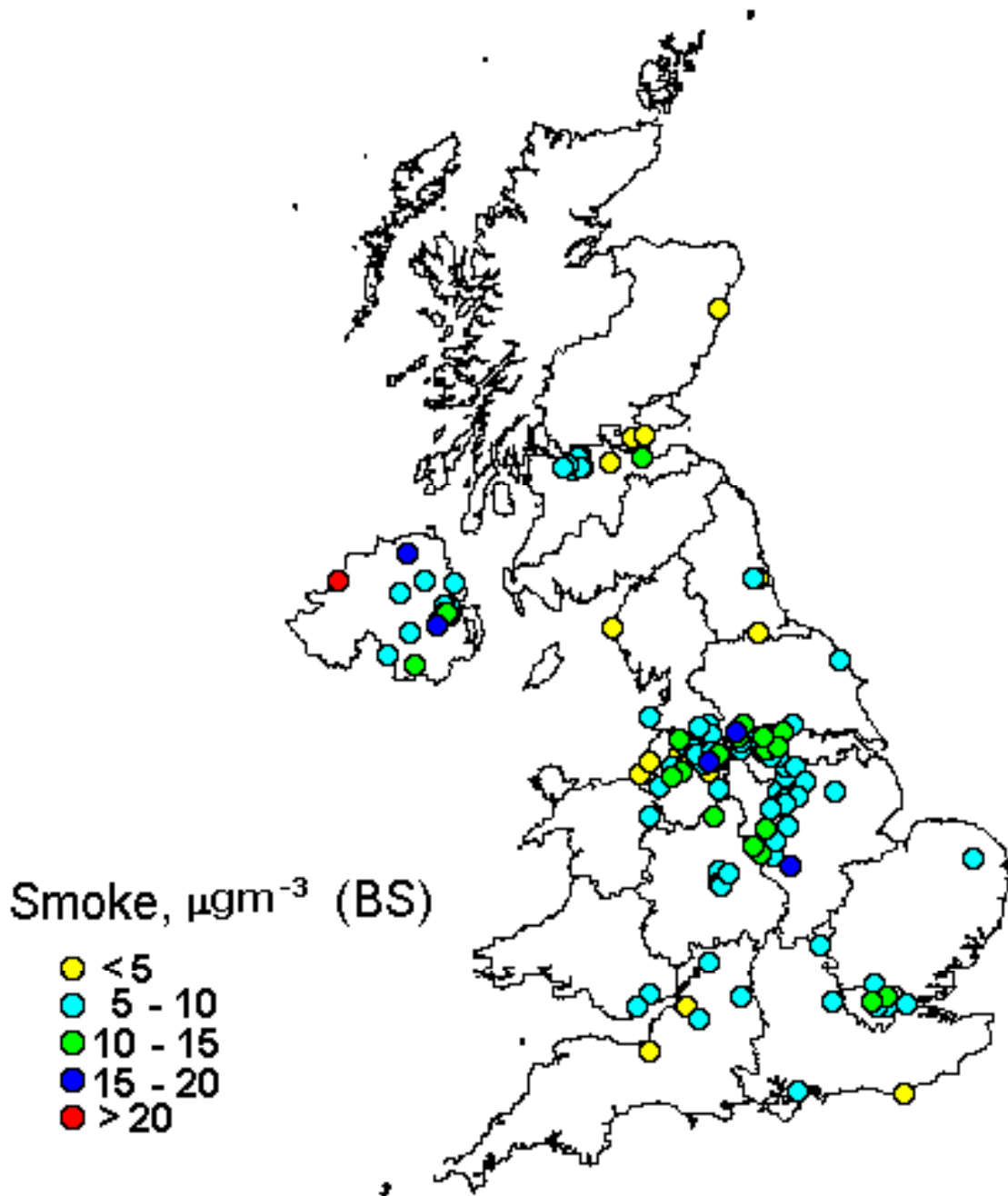
- Smoke: 8.2 $\mu\text{g m}^{-3}$ BS (9.6 $\mu\text{g m}^{-3}$ OECD).
- SO₂: 14.8 $\mu\text{g m}^{-3}$.

The 2001 average smoke concentration is slightly higher than the 2000 smoke average of 7.4 $\mu\text{g m}^{-3}$; this small increase is likely to be due to fluctuations in factors such as meteorology.

The 2001 average SO₂ is slightly lower than the average 2000 SO₂ of 15.4 $\mu\text{g m}^{-3}$, as measured by this Network. It should be noted that the Total Acidity method is likely to over-estimate network average SO₂ concentrations, due to the contribution from other acidic gases.

4.5 NATIONAL AND REGIONAL ANALYSIS

Figures 2 and 3 show annual means of smoke and SO₂ respectively, for the entire Network. Only sites with at least 75% data capture are shown. The data for calendar year 2001 show a similar pattern to that observed in previous years.



**Figure 2. Annual Mean Smoke Concentrations
(Only sites with at least 75% data capture are shown.)**

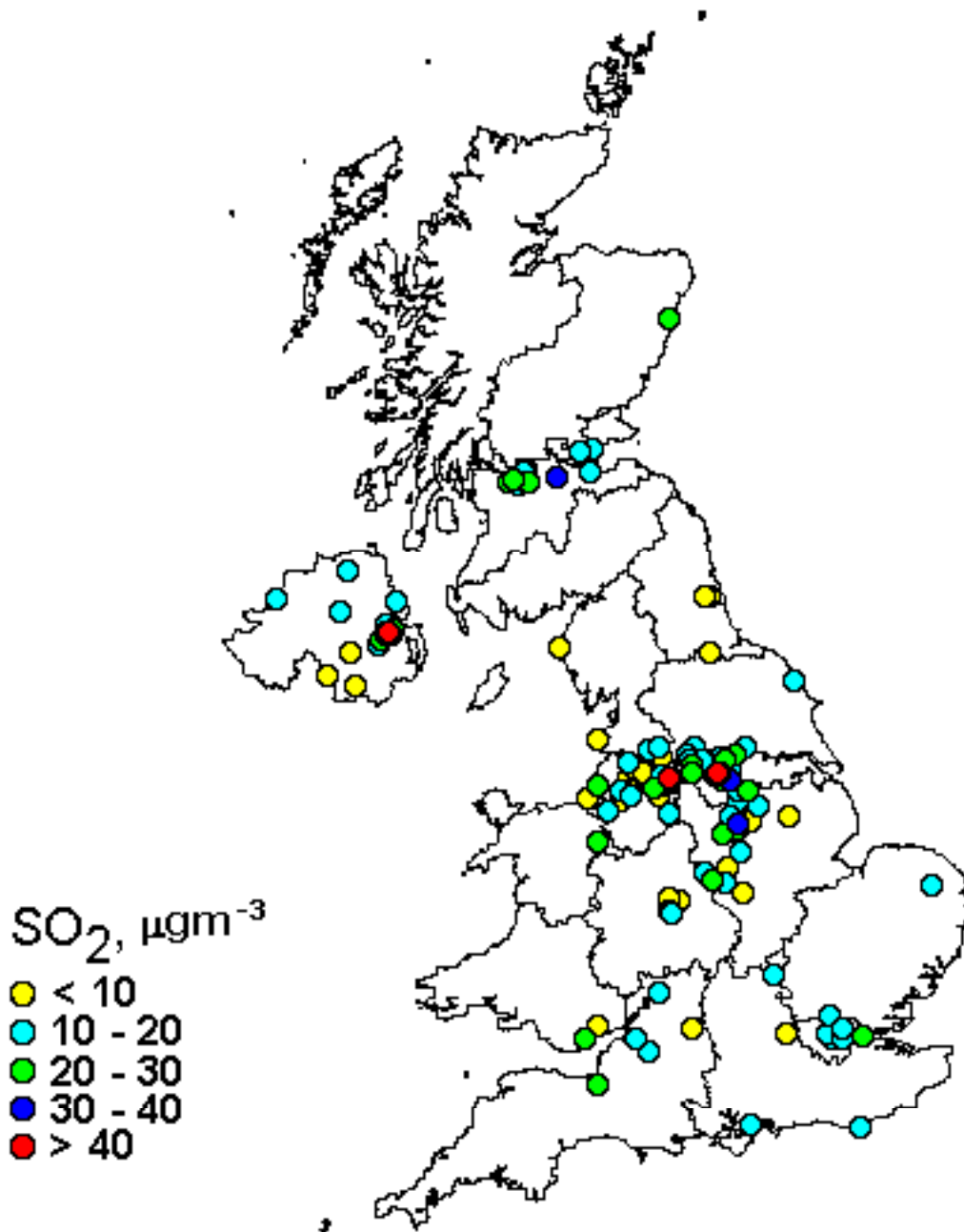


Figure 3. Annual Mean Concentrations of SO₂.
(Only sites with at least 75% data capture are shown.)

Table 2 summarises key statistics for England, Scotland, Wales and Northern Ireland.

Table 2. Statistical Summary for England, Scotland, Wales and Northern Ireland.

	<i>England</i>	<i>Scotland</i>	<i>Wales</i>	<i>N. Ireland</i>
Smoke ($\mu\text{g m}^{-3}$ BS)				
No. of sites with > 75% data	88	10	3	18
Min. Annual Mean	2.3	1.9	5.5	5.6
Ave. Annual Mean	8.2	5.6	7.2	11.7
Max. Annual Mean	18.8	8.2	8.6	34.0
SO₂ ($\mu\text{g m}^{-3}$)				
No. of sites with > 75% data	84	10	3	18
Min. Annual Mean	1.6	10.9	7.2	7.8
Ave. Annual Mean	14.9	19.5	16.2	22.0
Max. Annual Mean	43.7	33.3	21.4	43.4

Note: all statistics in Table 2 are based only on sites with at least 75% data capture.

4.5.1 England

Smoke in England: Annual mean smoke at English sites ranged from less than $3 \mu\text{g m}^{-3}$ (at the coastal town of Whitehaven, also at the three sites operated by Wigan MBC) to $18.8 \mu\text{g m}^{-3}$ at the city centre site HALIFAX 16. The highest smoke concentrations this year occurred predominantly at sites in city centre locations where particulate emissions from traffic contribute, such as LEICESTER 19 and MANCHESTER 11. The average for all sites in England was $8.2 \mu\text{g m}^{-3}$. This is consistent with the mean of $8.2 \mu\text{g m}^{-3}$ for the whole UK, based on core sites.

SO₂ in England: The highest SO₂ concentration in England, as measured by this Network, was $44 \mu\text{g m}^{-3}$ and occurred at BARNSELEY 8. This site is in an area where domestic coal use is relatively widespread. High SO₂ concentrations were also measured at other sites in the Barnsley area (CUDWORTH 2, GOLDTHORPE 1 and BARNSELEY 12), as well as OLDHAM 13 and MANSFIELD WOODHOUSE 2 in Nottinghamshire. The annual mean SO₂ for all English sites was $14.9 \mu\text{g m}^{-3}$. Again, this is consistent with the mean of $14.9 \mu\text{g m}^{-3}$ for the whole UK (based on core sites only).

4.5.2 Scotland

Smoke in Scotland: Annual mean smoke concentrations measured in Scotland were less than $10 \mu\text{g m}^{-3}$, at all sites except two (EDINBURGH 25 and KIRKINTILLOCH 10) which had less than 75% data capture and were therefore not included in this analysis. The annual mean smoke concentration for all Scottish sites was $5.6 \mu\text{g m}^{-3}$, lower than the Network average of $8.2 \mu\text{g m}^{-3}$.

SO₂ in Scotland: No Scottish sites exhibited particularly high annual mean SO₂ concentrations. The highest annual mean was $33 \mu\text{g m}^{-3}$, measured at ARMADALE 2. This is in a small town, but is close to industrial and domestic emission sources; high SO₂ concentrations have been measured here in previous years. The majority of sites in Edinburgh and Glasgow had annual mean SO₂ in the range 15 to $30 \mu\text{g m}^{-3}$. Elsewhere it was typically below $15 \mu\text{g m}^{-3}$. The mean for Scotland was $19.5 \mu\text{g m}^{-3}$ – higher than that measured for the whole Network.

4.5.3 Wales

Smoke in Wales: Annual means at all three sites were less than $10 \mu\text{g m}^{-3}$. However, the limited number of sites in Wales means that these statistics are unlikely to be representative of all urban areas in Wales.

SO₂ in Wales: Annual mean SO₂ concentrations at the three sites in Wales ranged from 7 $\mu\text{g m}^{-3}$ to 21 $\mu\text{g m}^{-3}$ for sites with at least 75% data capture.

4.5.4 Northern Ireland

Smoke in Northern Ireland: Annual mean smoke concentrations in Northern Ireland (with one exception) ranged from 5 $\mu\text{g m}^{-3}$ to 19 $\mu\text{g m}^{-3}$. The average for Northern Ireland was 11.7 $\mu\text{g m}^{-3}$; higher than the Network average of 8.2 $\mu\text{g m}^{-3}$. However, one site, STRABANE 2, measured a substantially higher annual mean smoke concentration of 34 $\mu\text{g m}^{-3}$. This site also recorded an unusually high concentration in 2000, and investigations indicated that the result was genuine. The site is located on a housing estate with considerable domestic coal and oil burning, and local topography may impede dispersion.

SO₂ in Northern Ireland: Relatively high concentrations of SO₂ have been measured in Northern Ireland, particularly Belfast, for many years. Availability of natural gas has historically been limited in this region, so greater use is made of coal and oil. The overall annual mean SO₂ for all Network sites in Northern Ireland was 22 $\mu\text{g m}^{-3}$; lower than the average of 27 $\mu\text{g m}^{-3}$ obtained for this region last year, but still considerably higher than the annual means obtained for the other regions, or for the UK as a whole. The highest annual mean SO₂ concentrations exceeded 40 $\mu\text{g m}^{-3}$, and were measured at sites in Belfast.

All four regions appeared to show slightly increased smoke concentrations in 2001 compared with 2000. Average regional smoke concentrations for 2001 (to the nearest $\mu\text{g m}^{-3}$) were as follows: England 8 $\mu\text{g m}^{-3}$, Scotland 5 $\mu\text{g m}^{-3}$, Wales 7 $\mu\text{g m}^{-3}$ and Northern Ireland 12 $\mu\text{g m}^{-3}$. Average regional smoke concentrations the previous year, 2000, were as follows: England 7 $\mu\text{g m}^{-3}$, Scotland 4 $\mu\text{g m}^{-3}$, Wales 6 $\mu\text{g m}^{-3}$ and Northern Ireland 11 $\mu\text{g m}^{-3}$.

By contrast, in England and Northern Ireland, SO₂ concentrations appear to have decreased in 2001. Average regional concentrations for 2001 (again, to the nearest $\mu\text{g m}^{-3}$) were as follows: England 15 $\mu\text{g m}^{-3}$, Scotland 20 $\mu\text{g m}^{-3}$, Wales 16 $\mu\text{g m}^{-3}$ and Northern Ireland 22 $\mu\text{g m}^{-3}$. Average regional SO₂ concentrations the previous year, 2000, were as follows: England 16 $\mu\text{g m}^{-3}$, Scotland 18 $\mu\text{g m}^{-3}$, Wales 11 $\mu\text{g m}^{-3}$ and Northern Ireland 27 $\mu\text{g m}^{-3}$. (In the case of Wales, the difference is likely to be due to the reduction in site numbers from five to three).

4.6 SEASONAL ANALYSIS

Smoke and SO₂ can exhibit a seasonal variation. Concentrations of both pollutants, but particularly black smoke, are typically higher in the winter months. The combustion of coal and oil is a major source of both pollutants; this increases during winter, mainly because of domestic and industrial heating requirements. Also cold, still weather conditions may impede dispersion of locally emitted pollutants, giving rise to "winter pollution" episodes when concentrations of smoke and SO₂ may be especially high.

Figures 4a and 4b show a time series graph of daily mean concentrations of smoke and SO₂ respectively, for 2001. These graphs show the average daily mean for England, Scotland, Wales and Northern Ireland separately. They are intended to illustrate seasonal variation in these pollutants, and also allow comparison of the seasonal patterns between these four regions.

In the case of smoke (Figure 4a), England, Scotland, Wales and Northern Ireland show a similar pattern. Highest smoke concentrations occur during the winter months, with several peaks indicating periods of high pollution. Two specific "episodes" of high pollutant concentrations are apparent. The first occurred around 16th-19th January 2001,

and affected much of the UK. Defra's Automatic Urban Network (AUN), which measures particulate matter as PM₁₀, also recorded high concentrations across the UK at this time. The second episode was around 11th-16th December 2001, and affected Northern Ireland, Scotland and the north of England. This peak was also recorded by AUN sites monitoring PM₁₀, specifically in the above regions.

In the case of SO₂, (Figure 4b), the seasonal patterns are different for the four regions. For Northern Ireland, SO₂ concentrations were highest in the early part of 2001, with several peaks in January and February. In this region, with its historically high domestic coal and oil use, SO₂ concentrations are typically higher in the winter. On several days, both smoke and SO₂ concentrations in Northern Ireland were high (for example 9th January, 19th January and 17th February).

By contrast, data from England showed a much less pronounced seasonal pattern; however, the days on which England's highest average SO₂ concentrations occurred were all in winter. England's peak SO₂ concentrations occurred around 16th-17th January, 14th February and 12th December – days when smoke concentrations were also high, indicating winter-type pollution episodes. Daily averages for Wales showed no strong seasonal pattern, but the very small number of sites makes it difficult to draw clear conclusions.

Scotland's network average SO₂ concentrations in 2001 showed an unexpected pattern, with the highest concentrations occurring between May and August 2001. However, when the daily averages for each of the 19 sites in Scotland were examined separately, this pattern was found at only those in eastern Scotland. Those in the Glasgow area and elsewhere showed no clear seasonal pattern. The small peak around 23rd August appears to result mainly from peaks observed at KIRKCALDY 6 and WHITBURN 3 in West Lothian. The reason for this peak is not clear, but the weather on that day was warm and cloudy with some fog; it is therefore likely that local (possibly industrial) sources were the cause. A small SO₂ peak was observed around this time at the Grangemouth automatic monitoring site, which is also close to industrial emission sources, where a 1-hour mean of almost 100ppb (266 µg m⁻³) was recorded on 24th August.

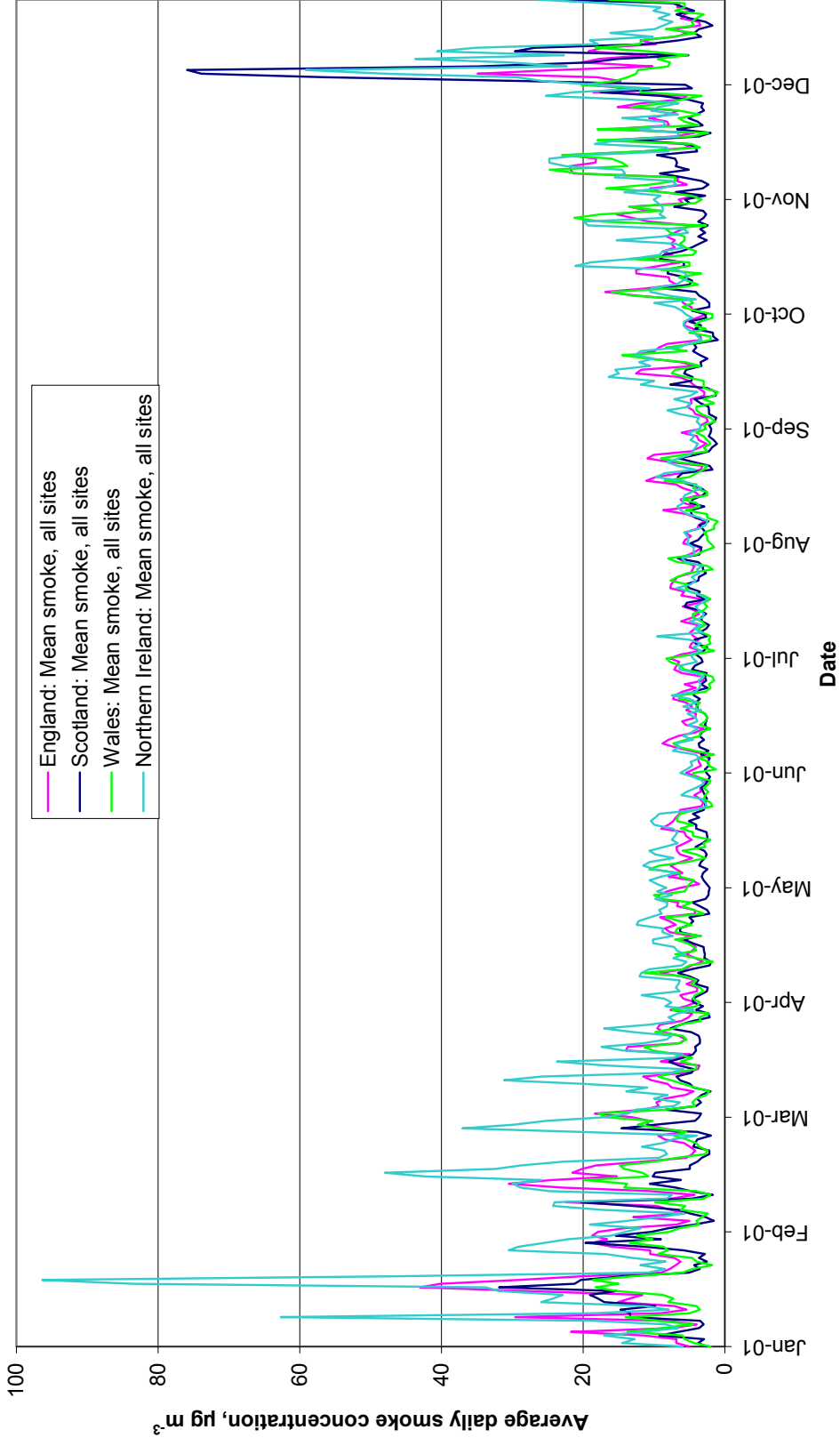


Figure 4a. Seasonal Variation in Average Daily Smoke Concentration

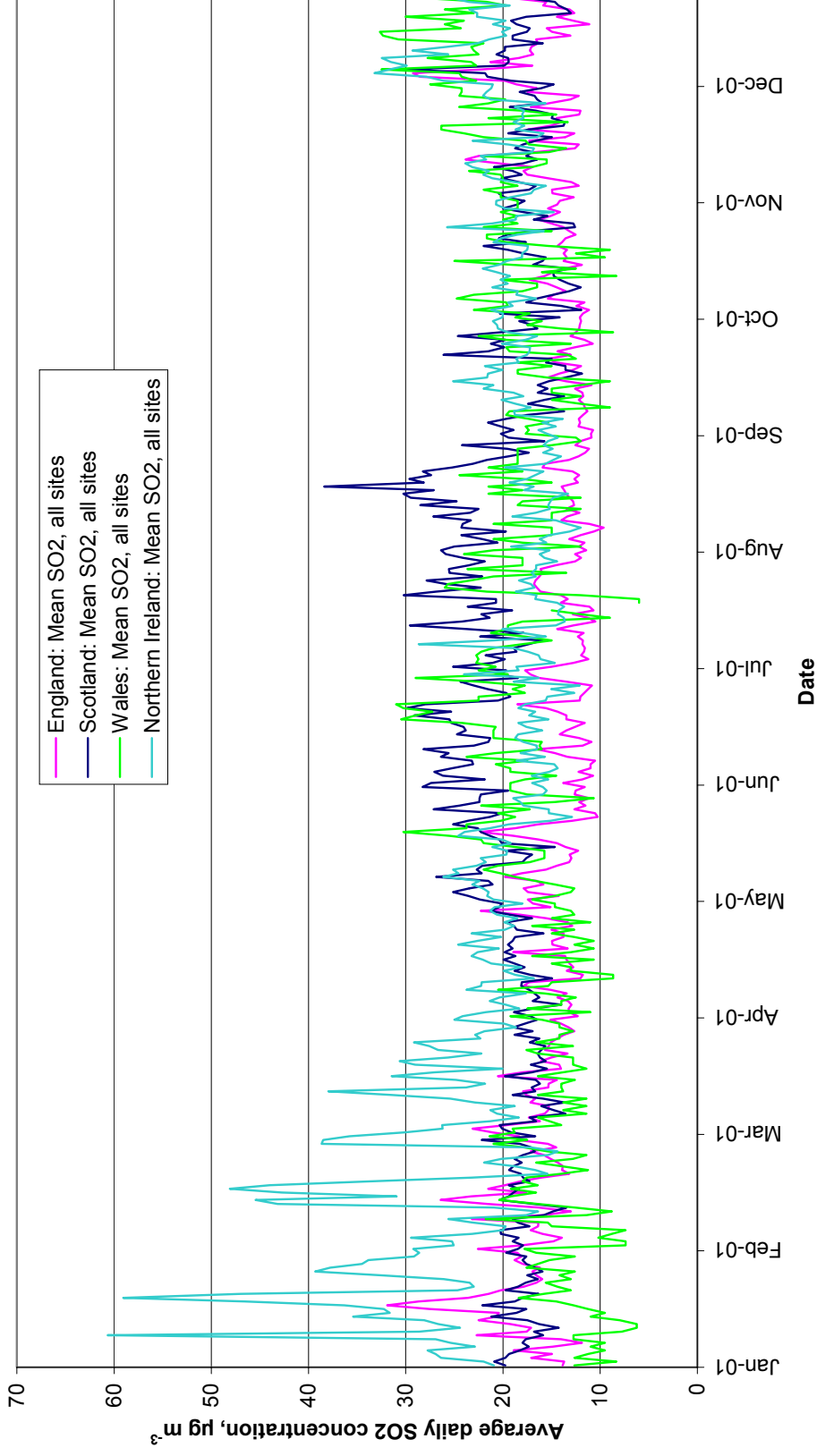


Figure 4b. Seasonal Variation in Average Daily SO₂ Concentration

5 Comparison with Air Quality Limit Values and Objectives

In previous years, data from the UK Smoke and SO₂ Network have been compared with the European Council Directive¹ 80/779/EEC on sulphur dioxide and suspended particulates. Although the limits of this older Directive remain in force until they are fully repealed in 2005, they are less stringent than those in the later 1st Daughter Directive and have been fully met throughout the UK since the early 1990s. Now that Network data are reported on a calendar year basis, comparison of results from the Smoke and SO₂ Network with this original Directive are reported separately to Defra each year. This report therefore compares results from the Smoke and SO₂ Network, for calendar year 2001, with applicable parts of the First Daughter Directive (1999/30/EEC).

In both the 1st Daughter Directive and the Air Quality Strategy, an "exceedence" of an air quality limit or guide value is defined as a concentration "greater than" the limit or guide value, as opposed to "greater than or equal to". This definition - "greater than" is therefore used in this report.

5.1 LIMITS AND OBJECTIVES FOR SO₂

Within Europe, sulphur dioxide is covered by the 1st Daughter Directive (1999/30/EC)³. This Directive, covering SO₂, NO₂, PM₁₀ and lead was published in April 1999 and came into force in July 2001. In the UK, the Air Quality Regulations (2000) for England⁶, Wales⁷, and Scotland⁸, and (2001) for Northern Ireland⁹ include standards and objectives for SO₂. These are explained in the Air Quality Strategy (January 2000)¹⁰. The EC limit values, and Air Quality Strategy standards and objectives, are shown in Table 3. All these limits are for protection of human health except where stated.

Table 3. Limit Values and Objectives for Sulphur Dioxide

Averaging period	Limit Value	No. of Permitted exceedences	To be achieved by
EC 1st Daughter Directive (1999/30/EC)			
1 hour	350 µg m ⁻³	24 per year	1 January 2005
24 hour	125 µg m ⁻³	3 per year	1 January 2005
Calendar year and winter (1st October – 31st March), for protection of vegetation (relevant in rural areas)	20 µg m ⁻³	-	19 July 2001
Air Quality Strategy			
15 minute	266 µg m ⁻³	35 per year	31 December 2005
1 hour	350 µg m ⁻³	24 per year	31 December 2004
24 hour	125 µg m ⁻³	3 per year	31 December 2004
Calendar year and winter (1st October – 31st March), for protection of vegetation (relevant in rural areas)	20 µg m ⁻³	-	31 December 2000

It is clearly not possible to compare data from the Smoke and SO₂ Network with the limit values or objectives relating to the 15-minute or hourly average SO₂ concentration. Nor is it relevant to compare data from this urban network with the annual and winter limits for protection of ecosystems, which are intended for protection of rural areas. However, it is possible to compare the daily SO₂ data from the Network with the 24 hour limit. In the calendar year January to December 2001, there were four sites with more than three days where the 24-hour average SO₂ was greater than the Daughter Directive Limit Value and AQS Standard for SO₂ of 125 µg m⁻³ : these were as follows:

BARNSLEY 8
 BELFAST 13
 BELFAST 33
 BELFAST 42

By convention, a factor of 1.25 should be applied to *peak* data obtained using the Total Acidity method, when comparing it with limit values relating specifically to SO₂. This is intended to take into account any additional uncertainty of the Total Acidity method at higher concentrations. After application of this factor, no additional sites had over three daily mean SO₂ concentrations greater than the limit value in calendar year 2001.

Most of the days on which the Daughter Directive Limit Value and AQS Standard of 125 µg m⁻³ was exceeded occurred during two specific "episodes" of high pollutant concentrations. The first occurred around 18th-19th January 2001, and affected Northern Ireland and northern parts of England. The second was around 11th-16th December 2001, and affected Northern Ireland, Scotland and the north of England.

5.2 LIMITS AND OBJECTIVES FOR SMOKE

The Daughter Directive particulate limits relate to PM₁₀, not black smoke, and therefore Network data cannot be directly compared with these. However, particularly in areas where domestic coal and oil combustion are prevalent, black smoke measurements can be useful for highlighting areas where high concentrations of PM₁₀ may occur: these areas can then be targeted for more detailed investigation.

The Air Quality Strategy¹⁰ also provides objectives for suspended particulate matter. These objectives also specifically apply to PM₁₀, not black smoke, and the Strategy acknowledges that these two techniques are not the same. Following a recent consultation process, in August 2002 Defra announced some changes to the AQS objectives, including the setting of further PM₁₀ objectives for 2010. The new objectives include separate PM₁₀ objectives specifically for London, (in acknowledgement of the capital's higher levels of industrial and transport activity), and for Scotland where PM₁₀ concentrations are generally lower.

The EC Directive limit values and AQS objectives are shown in Table 4. All limits and objectives are based on European reference method for PM₁₀ (a gravimetric technique), or equivalent. Black smoke data are not directly comparable.

Table 4. Limit Values and Objectives for Particulate Matter as PM₁₀.
All limit values refer to gravimetric equivalent measurements.

Averaging period	Limit Value	Number of Permitted Exceedences	To be achieved by
EC 1st Daughter Directive (1999/30/EC) Stage 1			
24 hour	50 µg m ⁻³	35 per year	1 st January 2005
Annual Mean	40 µg m ⁻³	-	1 st January 2005
EC 1st Daughter Directive (1999/30/EC) Stage 2 (to be confirmed)			
24 hour	50 µg m ⁻³	7 per year	1 st January 2010
Annual Mean	20 µg m ⁻³	-	1 st January 2010
Air Quality Strategy stage 1			
24 hour	50 µg m ⁻³	35 per year	31 st December 2004
Annual Mean	40 µg m ⁻³	-	31 st December 2004
Air Quality Strategy stage 2, England (except London) and Wales			
24 hour	50 µg m ⁻³	7 per year	31 st December 2010
Annual Mean	20 µg m ⁻³	-	31 st December 2010
Air Quality Strategy stage 2, Scotland			
24 hour	50 µg m ⁻³	7 per year	31 st December 2010
Annual Mean	18 µg m ⁻³	-	31 st December 2010
Air Quality Strategy stage 2, London			
24 hour	50 µg m ⁻³	10 per year	31 st December 2010
Annual Mean	23 µg m ⁻³	-	31 st December 2010

The updated Statutory Local Air Quality Management Guidance, available via the Defra web site <http://www.defra.gov.uk/environment/airquality/laqm/guidance/index.htm>, does not recommend that black smoke data are routinely used to assess compliance with the AQS Objectives above. This is because there is no simple relationship between black smoke and PM₁₀ which is applicable to every site. However, as black smoke can be considered a subset of PM₁₀, if black smoke exceeds either of the above limits, it is very likely that total PM₁₀ has also done so. This was the case for one site during 2001: STRABANE 2. At this site, more than 35 daily mean black smoke concentrations were greater than the 24-hour limit for PM₁₀. This site is located on a housing estate in Northern Ireland where domestic coal burning is prevalent and local topography may lead to poor dispersion.

6 Use of Smoke Data in Health Effect Studies

Although air quality limit values are increasingly being based on PM₁₀, it is important to note that black smoke data are still widely used in health effect studies, many of which have shown clear links between ambient concentrations of particulate pollution (as measured by the black smoke method) and adverse effects on human health. Some recent examples from other European countries are as follows:

1. An 8-year study carried out in the Netherlands¹¹, based on a cohort of 5000 people aged 55-69 established an estimated excess risk for cardiopulmonary mortality associated with traffic-related nitrogen dioxide and black smoke. An estimated excess risk was established for a background black smoke concentration of $10 \mu\text{g m}^{-3}$. Although the estimated excess risk of this background concentration alone was not statistically significant, when combined with modelled local emissions from busy roads it was established that living close to a busy road was a significant risk factor for cardiopulmonary death.
2. In Ireland¹², coal sales in the city of Dublin were banned in 1990, resulting in a sharp decrease in air pollution, including particulate pollution measured as black smoke. Respiratory and cardiovascular deaths decreased, coincident with the ban on coal sales.
3. A study of eight Spanish cities¹³ investigated the association of daily concentrations of black smoke and of SO_2 with daily deaths. Black smoke was found to have a nearly linear association with daily deaths, with no evidence of a threshold. A $10 \mu\text{g m}^{-3}$ increase in smoke concentration was associated with a 0.88% increase in daily deaths.

7 Trends and Comparison with Emission Estimates

The timeseries of the annual mean smoke and SO_2 concentrations for the UK as a whole are provided in Figure 5a and 5b respectively. The values shown in Figure 5a and 5b are averages from all sites in the network up to 1980, and thereafter from all sites in the core subset only. As explained in Section 2, this subset is intended to provide a representative selection of monitoring sites in urban areas throughout the UK. For consistency with previous years, the annual means shown in these figures are based upon the old "pollution calendar" years, which ran from April to March. The most recent annual means shown are for years April 2001-March 2002, which are $7.0 \mu\text{g m}^{-3}$ and $14.7 \mu\text{g m}^{-3}$ for smoke and SO_2 respectively. (It should be noted that these are slightly different from the calendar year means discussed previously). The resulting graphs show the rapid decrease in concentrations in the 1960s and 1970s and the more gradual decrease through the 1980s and 1990s. Figure 5a and 5b also show estimated total UK annual emissions of smoke and SO_2 for calendar years 1970 - 2000 (data for 2001 are not yet available), taken from the National Atmospheric Emissions Inventory. The graphs clearly show that ambient concentrations of these pollutants reflect declining emissions over this 30-year period.

The relationships between estimated annual emissions and measured annual mean concentrations have been explored further.

- **Smoke:** The plot shows a clear relationship between these two parameters over the 28 years. Regression analysis of the two parameters was carried out, giving a correlation coefficient (R^2) of 0.92. This is close to 1 and therefore indicates a very strong correlation.
- **SO_2 :** The relationship between the two parameters is also strong in the case of SO_2 : the correlation coefficient (R^2) of the regression equation is 0.88. The correlation is

slightly weaker than for smoke, which may reflect the fact that the Network measures total gaseous acidity rather than specifically SO₂.

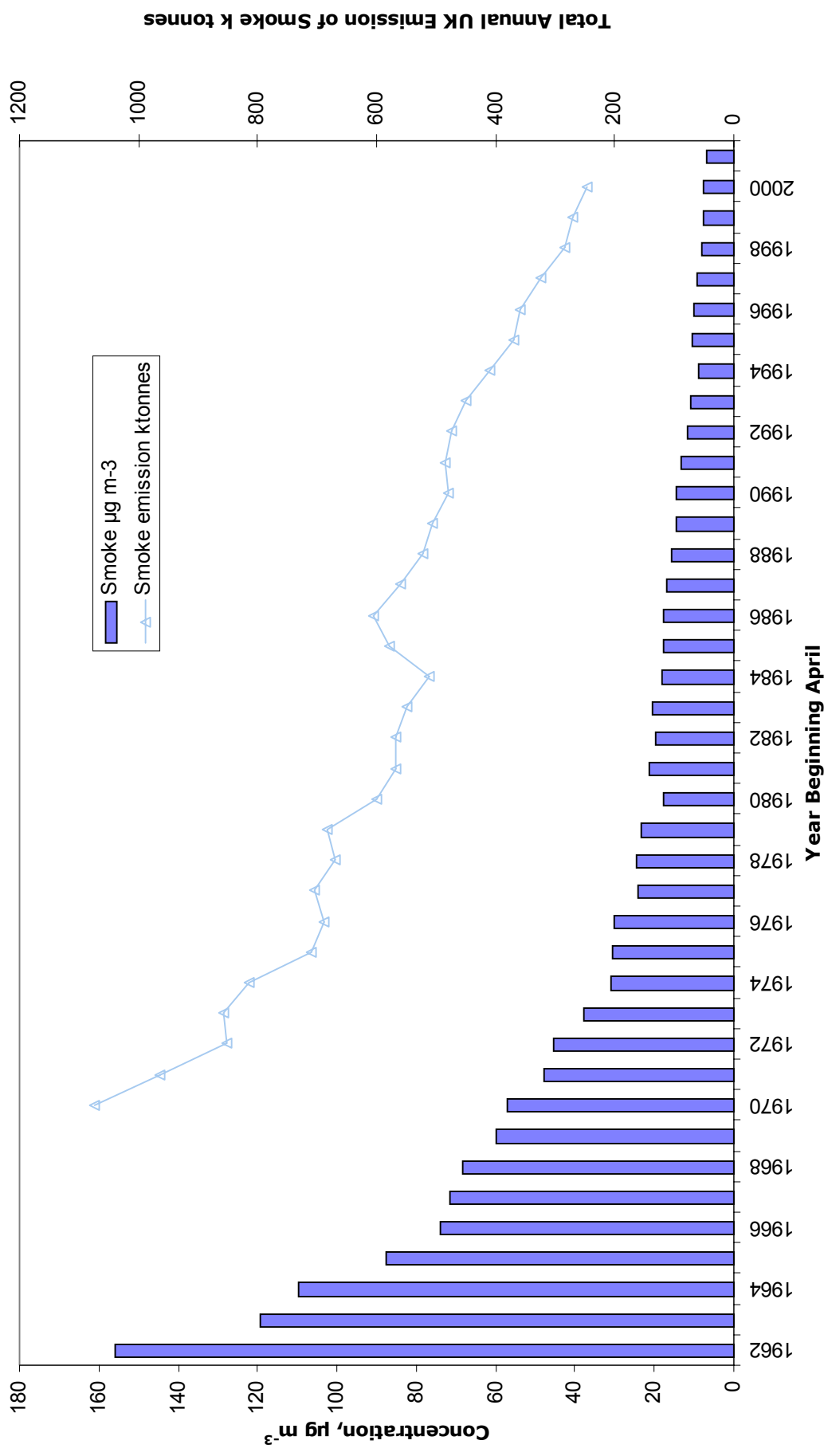


Figure 5a. Smoke only: Annual Emissions and Annual Mean Ambient Concentrations.

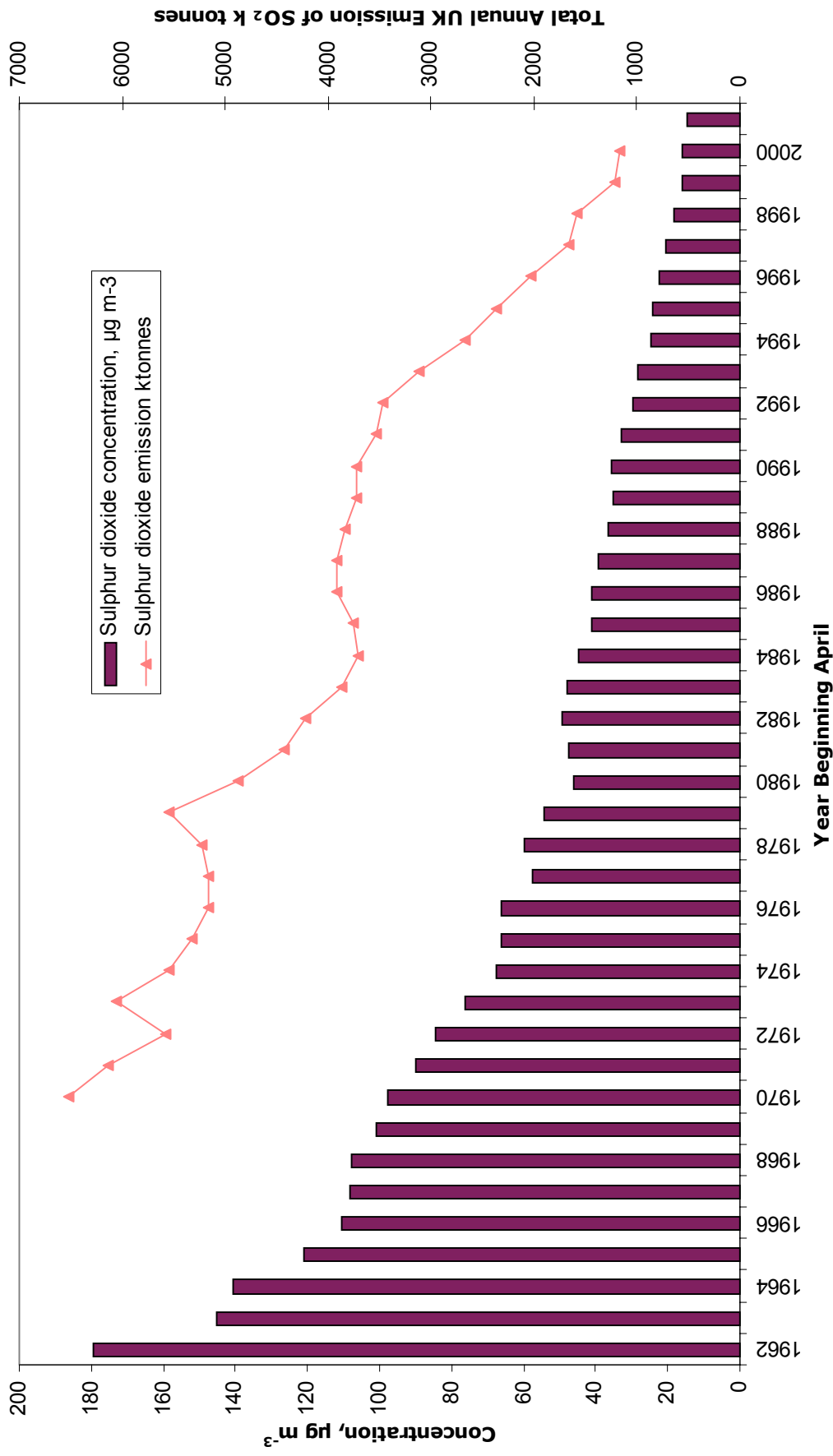


Figure 5b SO₂ only: Annual Emissions and Annual Mean Ambient Concentrations of SO₂.

8 Acknowledgements

All data presented in this report have been obtained by participating Local Authorities and supplied to **netcen** as part of this study. This contribution and cooperation from the Local Authorities is gratefully acknowledged. The central organisation of the study, analysis and quality assurance of the data by **netcen** has been funded by the Department for Environment, Food and Rural Affairs, the Scottish Executive, the Welsh Assembly Government and Department of the Environment in Northern Ireland as part of their Air and Environmental Quality research programme (Contract No. EPG 1/3/71 (A)).

9 References

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2. Council Directive 96/62/EC on Ambient Air Quality Assessment and Management.
3. Council Directive 1999/30/EEC relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air. 22 April 1999.
4. Establishing a Reciprocal Exchange of Information and of Data from the Network and Individual Stations Measuring Ambient Air Pollution in Member States. Decision 97/101/EEC.
5. Defra Digest of Environmental Statistics (produced annually). The Stationery Office.
6. The Air Quality (England) Regulations 2000 (Statutory Instrument 2000 No. 928), March 2000.
7. The Air Quality (Wales) Regulations 2000 (Statutory Instrument 2000 No. 1940 (W.138)), July 2000.
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13. J Schwartz et al. 'The concentration-response relation between air pollution and daily deaths' Environmental Health Perspectives Vol 109, No. 10 October 2001.

Table 1.1 Summary of Smoke and Sulphur Dioxide Results for Scotland, 2001. All concentrations in $\mu\text{g m}^{-3}$.

Code	Site name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2001					Summary of SO ₂ Data 2001				
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
SCOTLAND														
10003	ABERDEEN 3	Aberdeen	3931	8062	100	4	2	17	78	100	28	26	57	64
1100025	EDINBURGH 25	City of Edinburgh	3258	6731	73	11	10	31	56	72	19	18	35	53
1300020	GLASGOW 20	City of Glasgow	2595	6653	56	5	3	18	50	56	20	20	37	47
1300051	GLASGOW 51	City of Glasgow	2533	6641	78	8	4	48	177	81	22	19	38	50
1300069	GLASGOW 69	City of Glasgow	2568	6663	79	8	4	49	191	82	23	21	47	54
1300073	GLASGOW 73	City of Glasgow	2612	6627	77	7	3	36	135	79	15	14	33	93
1300095	GLASGOW 95	City of Glasgow	2679	6642	82	8	4	31	178	82	16	18	31	99
1300098	GLASGOW 98	City of Glasgow	2611	6678	53	9	6	49	75	55	19	20	35	42
1725008	KIRKINTILLOCH 8	East Dumbartonshire	2670	6741	98	6	4	36	102	98	11	12	29	60
1725009	KIRKINTILLOCH 9	East Dumbartonshire	2654	6732	97	7	4	45	106	98	14	13	25	63
1725010	KIRKINTILLOCH 10	East Dumbartonshire	2659	6741	6	21	11	85	111	6	16	16	22	25
155002	BALLINGRY 2	Fife	3178	6978	41	2	2	3	3	41	17	19	25	31
820301	COWDENBEATH 1	Fife	3165	6912	100	2	2	4	4	100	19	20	34	42
760005	COATBRIDGE 5	North Lanarkshire	2712	6638	72	5	3	24	36	70	20	18	53	62
760011	COATBRIDGE 11	North Lanarkshire	2738	6652	43	9	5	58	136	41	24	25	50	61
3070005	STIRLING (BURGH) 5	Stirling	2797	6946	57	4	3	21	25	52	13	13	26	39
1721006	KIRKCALDY 6	West Fife	3265	6933	87	4	3	13	30	81	12	12	31	67
69502	ARMADALE 2	West Lothian	2945	6681	85	2	2	8	17	84	33	25	78	96
3559003	WHITBURN 3	West Lothian	2948	6650	69	3	2	18	27	69	24	20	58	109

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.2 Summary of Smoke and Sulphur Dioxide Results for the North East, 2001. All concentrations in $\mu\text{g m}^{-3}$.

Code	Site name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2001					Summary of SO ₂ Data 2001				
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
NORTH EAST														
915013	DARLINGTON 13	Darlington	4291	5145	98	5	4	21	36	96	5	6	18	24
1290010	GATESHEAD 10	Gateshead	4256	5619	64	3	3	7	10	61	13	12	24	24
2370002	NEWBURN 2	Newcastle Upon Tyne	4199	5671	35	6	4	24	36	35	10	7	27	27
2370003	NEWBURN 3	Newcastle Upon Tyne	4195	5674	45	10	7	33	45	45	11	7	26	39
2390024	NEWCASTLE UPON TYNE 24	Newcastle Upon Tyne	4285	5650	100	5	3	23	48	100	7	7	20	33
2390027	NEWCASTLE UPON TYNE 27	Newcastle Upon Tyne	4251	5645	100	8	6	33	76	100	9	6	19	37
3170008	SUNDERLAND 8	Sunderland	4391	5585	29	13	9	40	93	29	23	23	64	76
85005	ASHINGTON 5	Wansbeck	4272	5877	34	6	5	20	27	33	22	18	60	78

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.3 Summary of Smoke and Sulphur Dioxide Results for the North West and Merseyside, 2001. All concentrations in $\mu\text{g m}^{-3}$.

Code	Site name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2001					Summary of SO ₂ Data 2001				
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
NORTH WEST & MERSEYSIDE														
3700003	WORKINGTON 3	Allerdale	2999	5287	11	9	3	33	42	11	10	7	21	21
3800006	BLACKPOOL 6	Blackpool	3317	4367	95	7	5	29	47	96	8	6	18	26
400024	BOLTON 24	Bolton	3715	4092	80	9	7	32	98	78	9	7	20	40
1230008	FARNWORTH 8	Bolton	3739	4061	84	9	7	32	50	84	8	6	19	37
1550001	HORWICH 1	Bolton	3637	4118	84	7	5	25	36	84	8	6	19	38
500012	BURNLEY 12	Burnley	3841	4324	99	8	5	32	51	99	13	13	26	40
510009	BURY 9	Bury	3819	4116	18	11	6	51	120	18	24	23	41	53
555014	CARLISLE 14	Carlisle City Council	3397	5551	67	7	5	28	150	67	0	0	6	6
715006	CHORLEY 6	Chorley	3585	4178	88	12	8	52	122	85	13	13	33	60
3563005	WHITEHAVEN 5	Copeland	2974	5178	88	2	1	14	28	87	8	6	12	18
840009	CREWE 9	Crewe and Nantwich	3703	3550	36	14	9	74	124	36	16	17	32	41
1130012	ELLESMERE PORT 12	Ellesmere Port	3398	3759	100	7	4	31	61	100	15	12	29	50
2781510	RUNCORN 10	Halton	3511	3833	98	12	8	52	80	98	8	7	19	20
20005	ACORNINGTON 5	Hyndburn	3758	4285	98	10	8	37	63	98	11	12	25	37
1850016	LIVERPOOL 16	Liverpool	3345	3908	8	18	9	58	60	8	19	13	43	50
2232507	MACCLESFIELD 7	Macclesfield	3926	3733	72	8	7	15	36	72	17	12	41	55
2280011	MANCHESTER 11	Manchester	3838	3981	100	15	12	50	102	100	11	12	25	43
2280015	MANCHESTER 15	Manchester	3875	3985	100	10	6	40	99	100	9	6	19	25
2280021	MANCHESTER 21	Manchester	3847	4023	100	9	5	38	79	100	7	6	13	19
2470013	OLDHAM 13	Oldham	3920	4057	84	13	12	25	34	83	40	39	71	90
2320003	MIDDLETON 3	Rochdale	3871	4063	97	9	7	32	95	97	18	19	31	37
150005	BACUP 5	Rossendale	3868	4231	78	8	7	22	33	78	8	6	18	27
2650007	RAWTENSTALL 7	Rossendale	3812	4229	64	12	10	38	74	64	12	12	31	49
855003	CROSBY 3	Sefton	3321	3990	86	5	3	26	44	86	20	19	37	43
2800036	ST HELENS 36	St Helens	3534	3936	93	8	5	35	71	93	10	6	19	25
2800043	ST HELENS 43	St Helens	3512	3955	92	8	5	41	79	91	11	7	29	63
625006	CHEADLE & GATLEY 6	Stockport	3859	3886	98	5	3	22	33	98	6	6	19	50
90008	ASHTON-UNDER-LYNE 8	Tameside	3939	3992	100	9	7	25	91	100	9	7	26	39
3314601	TRAFFORD 1	Trafford	3810	3958	100	5	3	24	47	98	29	25	61	105
3430017	WARRINGTON 17	Warrington	3607	3890	99	10	7	48	67	99	13	12	24	25
88201	ASHTON-IN-MAKERFIELD 1	Wigan	3576	3991	82	3	2	5	7	82	2	0	7	13
1800004	LEIGH 4	Wigan	3662	3999	88	3	3	7	11	88	3	0	13	13
3610008	WIGAN 8	Wigan	3592	4056	80	3	3	7	9	80	2	0	7	13
3532002	WEST KIRBY 2	Wirral	3212	3874	99	3	2	14	30	98	7	6	19	31

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.4 Summary of Smoke and Sulphur Dioxide Results for Yorkshire and the Humber, 2001. All concentrations in $\mu\text{g m}^{-3}$.

Code	Site name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2001					Summary of SO ₂ Data 2001				
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
YORKSHIRE & THE HUMBER														
190008	BARNLEY 8	Barnsley	4348	4094	96	12	7	47	68	96	44	32	174	228
190012	BARNLEY 12	Barnsley	4342	4067	100	6	4	25	43	100	32	30	56	73
190013	BARNLEY 13	Barnsley	4375	4054	46	10	6	42	67	45	21	18	42	42
877502	CUDWORTH 2	Barnsley	4387	4091	88	10	7	38	70	88	34	31	65	112
1308701	GOLDTHORPE 1	Barnsley	4462	4043	100	9	6	40	76	100	31	31	64	90
1344002	GRIMETHORPE 2	Barnsley	4414	4091	48	10	7	40	59	48	33	32	54	62
2208501	LUNDWOOD (BARNLEY) 1	Barnsley	4372	4069	10	21	14	77	92	10	40	40	61	61
2208502	LUNDWOOD (BARNLEY) 2	Barnsley	3720	675	65	11	8	37	48	65	27	27	61	101
3670002	WOMBWELL 2	Barnsley	4401	4030	46	11	7	43	76	46	26	25	57	70
3715002	WORSBROUGH BRIDGE 2	Barnsley	4356	4040	48	9	5	35	50	48	31	31	59	62
430006	BRADFORD 6	Bradford	4163	4329	88	13	11	42	71	89	11	12	31	64
1650011	KEIGHLEY 11	Bradford	4061	4412	67	8	5	25	74	68	8	6	20	26
1120002	ELLAND 2	Calderdale	4109	4209	94	10	8	38	59	94	16	13	34	78
1360016	HALIFAX 16	Calderdale	4093	4254	87	19	18	41	90	87	15	12	31	69
3750009	YORK 9	City & County of York	4601	4521	49	6	4	27	42	49	10	7	23	52
1690019	KINGSTON-UPON-HULL 19	Kingston Upon Hull	5082	4284	24	17	10	51	184	24	15	13	32	63
962512	DEWSBURY 12	Kirklees	4235	4212	89	7	4	32	52	88	18	14	46	54
1515005	HOLMFRITH 5	Kirklees	4144	4085	88	7	5	32	84	88	25	24	47	76
1570019	HUDDESFIELD 19	Kirklees	4143	4164	98	8	6	33	49	98	21	20	40	61
445001	BRAMPTON 1	Rotherham	4414	4019	98	10	6	38	86	98	26	24	75	120
965004	DINNINGTON 4	Rotherham	4528	3861	96	7	5	27	61	96	13	12	42	60
2270002	MALBY 2	Rotherham	4530	3922	90	7	5	26	31	90	17	18	40	50
3465006	WATH-UPON-DEARNE 6	Rotherham	4433	4009	96	8	5	38	80	96	19	12	64	92
2839001	SCARBOROUGH 1	Scarborough	5036	4885	97	9	7	36	53	97	11	12	24	55
2872505	SELBY 5	Selby	4612	4322	100	7	5	24	52	100	11	12	19	24
22501	ACKWORTH 1	Wakefield	4440	4167	100	9	6	33	49	100	17	18	37	60
580011	CASTLEFORD 11	Wakefield	4519	4255	98	12	9	43	84	98	22	18	61	104
1235001	FEATHERSTONE 1	Wakefield	4429	4195	95	10	8	37	50	95	23	18	60	110
1450003	HEMSWORTH 3	Wakefield	4428	4134	100	8	6	31	49	97	16	12	43	73
1732003	KNOTTINGLEY 3	Wakefield	4497	4239	100	10	8	35	63	100	18	19	40	71
2415004	NORMANTON 4	Wakefield	4388	4228	100	7	5	28	53	99	10	7	38	71
2533510	PONTEFRACT 10	Wakefield	4473	4217	100	7	5	29	39	100	14	13	40	73
2966301	SOUTH KIRKBY 1	Wakefield	4456	4112	100	13	9	50	104	99	19	18	46	69
3350026	WAKEFIELD 26	Wakefield	4331	4208	100	15	12	49	90	99	10	7	27	68

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.5 Summary of Smoke and Sulphur Dioxide Results for the East Midlands, 2001. All concentrations in $\mu\text{g m}^{-3}$.

Code	Site name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2001						Summary of SO ₂ Data 2001					
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day		
EAST MIDLANDS																
40004	ALFRETON 4	Amber Valley	4417	3555	98	9	5	42	85	98	28	30	43	49		
348001	BIRCOTES 1	Bassetlaw	4627	3920	99	8	5	31	85	99	21	19	65	105		
2677503	RETFORD 3	Bassetlaw	4707	3811	97	8	5	39	81	97	17	19	33	66		
3710012	WORKSOP 12	Bassetlaw	4585	3787	10	14	13	39	41	11	9	7	31	36		
395005	BOLSOVER 5	Bolsover	4475	3706	74	7	5	25	54	85	15	12	44	88		
2967002	SOUTH NORMANTON 2	Bolsover	4442	3564	84	8	5	29	52	95	9	6	32	45		
960024	DERBY 24	Derby	4354	3369	92	10	8	37	60	32	12	14	28	77		
1790019	LEICESTER 19	Leicester	4588	3041	90	16	13	41	52	85	9	12	18	25		
1840005	LINCOLN 5	Lincoln	4974	3714	100	7	5	26	62	99	8	6	19	25		
2281010	MANSFIELD 10	Mansfield	4532	3607	95	8	6	34	75	94	21	18	54	85		
2281102	MANSFIELD WOODHOUSE 2	Mansfield	4538	3642	89	7	6	25	32	89	31	25	71	93		
2364502	NEW OLLERTON 2	Newark	4664	3682	99	8	6	26	37	99	9	6	20	30		
577501	CASTLE DONINGTON 1	NW Leicestershire	4448	3275	85	9	7	33	46	84	9	7	27	55		
750005	COALVILLE 5	NW Leicestershire	4428	3142	75	6	4	20	26	74	13	14	28	48		
2324001	MOIRA (LEICS) 1	NW Leicestershire	4328	3168	86	10	7	40	70	84	26	27	70	125		
2440020	NOTTINGHAM 20	Nottingham	4575	3403	88	9	7	33	45	87	17	18	50	62		

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.6 Summary of Smoke and Sulphur Dioxide Results for the West Midlands, 2001. All concentrations in $\mu\text{g m}^{-3}$.

Code	Site name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2001					Summary of SO ₂ Data 2001				
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
WEST MIDLANDS														
995002	DUDLEY 2	Dudley	3940	2897	74	6	4	21	36	74	12	12	25	36
2870005	SEDGLEY 5	Dudley	3919	2934	21	19	15	58	71	21	11	6	26	32
507513	BURTON-UPON-TRENT 13	East Staffordshire	4242	3233	70	10	8	43	65	70	15	13	38	135
2752503	ROWLEY REGIS 3	Sandwell	3964	2879	98	8	6	31	57	98	13	13	30	31
3090020	STOKE-ON-TRENT 20	Stoke-On-Trent	3888	3475	87	11	8	39	61	38	20	19	39	39
3380018	WALSALL 18	Walsall	4014	2987	90	8	6	36	51	90	6	6	27	43
3470002	WEDNESFIELD 2	Wolverhampton	3946	3002	99	6	4	26	56	98	8	6	24	30

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.7 Summary of Smoke and Sulphur Dioxide Results for Wales, 2001. All concentrations in $\mu\text{g m}^{-3}$.

Code	Site name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2001					Summary of SO ₂ Data 2001				
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
WALES														
540012	CARDIFF 12	Cardiff	3193	1773	78	9	6	30	40	78	21	20	38	51
1305301	GLYNNEATH 1	Neath	2880	2066	62	5	3	15	24	62	30	31	47	51
2400026	NEWPORT (MON) 26	Newport	3313	1878	96	8	5	26	48	96	7	6	19	19
2414001	NEYLAND 1	Preseli	1964	2052	24	5	4	16	20	24	1	0	6	12
3732510	WREXHAM 10	Wrexham	3324	3501	99	5	4	22	32	99	20	19	36	42

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.8 Summary of Smoke and Sulphur Dioxide Results for the Eastern region, 2001. All concentrations in $\mu\text{g m}^{-3}$.

Code	Site name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2001				Summary of SO ₂ Data 2001					
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
EASTERN														
240010	BEDFORD 10	Bedford	5056	2486	9	6	6	12	13	9	7	7	16	20
2430007	NORWICH 7	Norwich	6233	3099	80	6	4	20	51	80	13	12	31	37
3265013	THURROCK 13	Thurrock	5622	1791	100	7	5	30	51	100	21	19	39	58

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.9 Summary of Smoke and Sulphur Dioxide Results for London, 2001. All concentrations in $\mu\text{g m}^{-3}$.

Code	Site name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2001					Summary of SO ₂ Data 2001				
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
1950016	LONDON CITY 16	City of London	5324	1814	77	11	9	32	40	74	12	12	25	49
1060007	EALING 7	Ealing	5174	1807	51	7	5	20	43	52	13	12	23	29
1140014	ENFIELD 14	Enfield	5338	1958	79	8	5	35	70	79	17	18	32	47
1343709	GREENWICH 9	Greenwich	5382	1773	96	7	5	21	38	95	11	12	24	36
3696009	WOOLWICH 9	Greenwich	5441	1769	75	6	4	27	45	75	15	14	27	40
1590006	ILFORD 6	Redbridge	5440	1864	83	11	9	35	58	83	19	18	30	36
3541517	WESTMINSTER 17	Westminster	5298	1789	20	12	10	31	38	19	5	6	12	18

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.10 Summary of Smoke and Sulphur Dioxide Results for the South East, 2001. All concentrations in $\mu\text{g m}^{-3}$.

Code	Site name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2001					Summary of SO ₂ Data 2001						
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day		
SOUTH EAST																
1080005	EASTBOURNE 5	Eastbourne	5607	988	72	2	1	10	20	73	10	7	25	27		
390302	BLETCHLEY 2	Milton Keynes	4857	2337	96	5	3	21	43	96	13	13	26	35		
2560010	PORTSMOUTH 10	Portsmouth	4652	1019	82	5	4	17	36	82	12	12	42	61		
2940016	SLOUGH 16	Slough	4962	1819	82	7	6	18	28	83	7	6	12	18		

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.1.1 Summary of Smoke and Sulphur Dioxide Results for the South West, 2001. All concentrations in $\mu\text{g m}^{-3}$.

Code	Site name	Authority	OS Grid Ref to 100m		Summary of Smoke Data in 2001				Summary of SO ₂ Data 2001					
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
SOUTH WEST														
205006	BATH 6	Bath	3754	1656	95	8	6	28	34	91	10	12	24	37
470026	BRISTOL 26	Bristol	3634	1763	93	4	3	18	38	93	19	19	41	50
1305004	GLOUCESTER 4	Gloucester	3832	2179	98	7	4	32	53	97	11	13	26	33
453003	BRIDGWATER 3	Sedgemoor	3298	1373	95	4	3	15	36	93	20	19	42	66
3220002	SWINDON 2	Swindon	4147	1858	87	6	4	27	40	87	9	12	18	24

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Table 1.12 Summary of Smoke and Sulphur Dioxide Results for Northern Ireland, 2001. All concentrations in $\mu\text{g m}^{-3}$.

Code	Site name	Authority	Irish Grid Ref to 100m		Summary of Smoke Data 2001					Summary of SO ₂ Data 2001				
			East	North	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day	Data Capt. %	Arith. Mean	Median	98th %ile	Max. Day
NORTHERN IRELAND														
69701	ARMAGH 1	Armagh	2877	3450	61	9	7	38	55	60	16	14	25	28
1637001	KEADY 1	Armagh	2845	3341	73	8	7	27	71	71	3	0	12	19
160003	BALLYMENA 3	Ballymena	3103	4029	70	8	4	40	64	69	28	30	60	78
161504	BALLYMONEY 4	Ballymoney	2954	4259	100	17	11	70	303	100	13	13	20	40
270012	BELFAST 12	Belfast	3324	3737	96	10	6	62	113	96	18	13	63	87
270013	BELFAST 13	Belfast	3357	3740	100	10	7	43	112	100	38	38	96	160
270033	BELFAST 33	Belfast	3346	3755	98	13	9	49	124	98	43	38	120	160
270042	BELFAST 42	Belfast	3322	3748	100	10	7	43	92	100	41	38	102	160
270044	BELFAST 44	Belfast	3338	3740	98	6	4	19	55	98	33	32	58	141
270045	BELFAST 45	Belfast	3335	3723	100	9	7	33	113	100	36	32	70	134
270046	BELFAST 46	Belfast	3803	3334	100	6	4	23	43	100	29	26	58	134
2551504	PORTADOWN 4	Craigavon	3012	3538	86	8	5	37	67	79	9	6	24	24
2190012	LONDONDERRY 12	Derry	2438	4200	34	8	5	34	42	31	26	25	71	118
2190014	LONDONDERRY 14	Derry	2443	4174	32	9	6	29	58	29	18	13	47	67
1025001	DUNGANNON 1	Dungannon	2802	3629	60	5	4	11	13	59	15	13	30	49
1757703	LARNE 3	Larne	3400	4029	96	9	6	34	79	96	18	19	25	32
1032502	DUNMURRY 2	Lisburn	3289	3679	10	15	13	44	49	10	27	27	50	58
1032503	DUNMURRY 3	Lisburn	3287	3875	80	11	6	61	185	79	20	20	50	58
1845003	LISBURN 3	Lisburn	3263	3636	93	16	8	87	221	93	17	13	41	63
3325001	TWINBROOK 1	Lisburn	3281	3689	94	11	6	49	209	92	20	20	50	74
2233501	MAGHERAFELT 1	Magherafelt	2896	3901	94	9	5	56	76	96	13	13	26	32
2410003	NEWRY 3	Newry and Mourne	3078	3268	83	11	5	74	164	85	8	6	20	25
2412501	NEWTOWNABBEY 1	Newtownabbey	3349	3824	94	9	5	40	68	94	13	12	25	49
2412502	NEWTOWNABBEY 2	Newtownabbey	3318	3825	96	10	6	45	91	96	15	13	25	44
2412503	NEWTOWNABBEY 3	Newtownabbey	3321	3851	5	8	5	23	25	5	7	6	13	13
165005	BANGOR (CO DOWN) 5	North Down	3497	3810	59	16	8	77	158	59	11	12	23	48
1517501	HOLYWOOD 1	North Down	3397	3784	59	6	4	23	30	59	11	12	19	25
3111502	STRABANE 2	Strabane	2351	3972	89	34	26	114	249	89	12	13	26	67

The following abbreviations are used in Table 1:

1. "Data Capt. %" is the percentage of the year for which valid data was obtained.
2. "Arith. Mean" is the arithmetic mean of all daily values, calculated as described in Appendix 1.
3. "Median" is the median, or 50th percentile, of all daily values, calculated as described in Appendix 1.
4. "98th %ile" is the 98th percentile of all daily values, see Appendix 1.
5. "Max. Day" is the maximum daily value measured during the year.

Appendices

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Appendix 1

Calculation of Results and Statistics

CONTENTS

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Period Covered by Observations

This report covers the calendar year 1st January to 31st December 2001.

The UK Smoke and Sulphur Dioxide Network is operated on the basis of the "Pollution Calendar". The pollution year always begins on the Tuesday nearest to 1 April, and contains twelve months, each of exactly 4 or 5 weeks, all beginning on Tuesdays. Pollution months April to September make up the summer period, and October to March constitute the winter period. While this "Pollution Calendar" is for operational purposes, to conveniently divide the year up into 'months' comprising whole numbers of weeks (as the samplers are normally visited weekly), data are now reported on a calendar year basis, in line with all other Networks operated on behalf of Defra. Details of the pollution calendar are available from netcen on request.

Derivation of Results

The data are processed by computer, from daily measurements made by the participating Local Authorities and other organisations. The formulae used for calculation of smoke concentrations, i.e. for relating blackness of the filter to the mass of smoke per unit volume of air sampled, have been used since winter 1961-62. The formula used for calculating SO₂ concentrations has never been changed.

As in previous years, the validity of the original readings has been checked by means of an editing program.

Significance of Results

It is important to note that in making comparisons of pollution in different towns, careful account must be taken of the details of the sites for which measurements are available in relation to the geographical structure of the town. That is, to the situation, extent and types of industrial, residential and commercial areas. Local variations in fuel type and quality can also have a significant effect on the measurements.

Formulae used in Calculating Concentrations

(a) Smoke

Smoke concentrations have been calculated by the use of the British Standard Smoke Calibration Curve (BS 1747: Part 2: 1991).

For reflectometer readings of 40 to 99 the following formula is used:

$$C = \frac{F}{V} (91,679.22 - 3,332.0460 R + 49.618884 R^2 - 0.35329778 R^3 + 0.0009863435 R^4)$$

Where:

- C = concentration in micrograms per cubic metre
V = volume of air sampled, in cubic feet (in the majority of cases, a metric meter is used, and the volume in cubic metres is converted to cubic feet by multiplying by 35.315)
F = a factor relating to the sampler clamp size, as follows:
 0.288 for $\frac{1}{2}$ inch clamp,
 1.00 for 1 inch clamp,
 3.68 for 2 inch clamp, or
 12.80 for 4 inch clamp
R = reflectometer reading

This formula represents the calibration curve to within $\pm 1.3\%$ over the range of reflectometer readings between 40 and 90. When used to calculate concentrations from reflectometer readings between 91 and 98 the results may be underestimated by as much as 6%.

For darker stains with reflectometer readings between 40 and 20 the formula used is:

$$C = \frac{F}{V} (214,245.1 - 15,130.512 R + 508.181 R^2 - 8.831144 R^3 + 0.0628057 R^4)$$

For stains with reflectometer readings of less than 20 this formula gives only an approximation to the concentration, the result being well below the true value. Reflectometer readings of less than 10 are impossible to assess accurately and hence the results are calculated as if the reading had been 10, which at least gives a minimum value. However, such low reflectometer readings, corresponding to very high smoke concentrations, are now rare in the UK.

(b) Sulphur Dioxide

Sulphur dioxide concentrations have been calculated by the method described in BS 1747: Part 3: 1991. The formula used to calculate sulphur dioxide concentrations is:

$$C = \frac{4520}{V} m$$

where

C = concentration in micrograms per cubic metre

m = volume of 0.002M (N/250) di-sodium tetraborate used, in millilitres,

V = volume of air sampled, in cubic feet (again, in the majority of cases, a metric meter is used, and the volume in cubic metres is converted to cubic feet by multiplying by 35.315)

Formulae Used In Calculating Annual Statistics

(a) Arithmetic Mean (AM)

$$AM = \frac{\sum_{i=1}^N C_i}{N}$$

where

AM is annual arithmetic mean

C_i is daily concentration for day i

N is number of results available for the year

(b) Percentiles (50%, 98% etc.) Note - the median is the 50th percentile.

Daily concentrations are sorted into ascending order of concentration value, C₁, C₂, C₃, ..., C_i, ..., C_N and the associated percentile value for each concentration value is found from

$$P_i = \left(\frac{i}{N+1} \right) 100$$

where

P_i is the percentile for the ith concentration in the sorted set, that is, P_i% of the concentrations will be **equal to or less than** C_i

N is the number of results available for the year

The concentration values for the fixed percentile values quoted are obtained by linear interpolation between the concentration values for the nearest percentile values on either side.

For example, in the sets

$P_1, P_2, \dots, P_i, \dots, 98.8, 99.3, \dots, P_N$

$C_1, C_2, \dots, C_i, \dots, 150, 160, \dots, C_N$

the 99th percentile would be $154 \mu\text{g m}^{-3}$

Units

The unit employed for expressing both smoke and sulphur dioxide concentrations from this Network, both in this report and on the disk, is the microgram per cubic metre ($\mu\text{g m}^{-3}$). However, concentrations of gaseous pollutants such as SO_2 are sometimes expressed as parts per billion by volume (abbreviated to "ppb").

For SO_2 , the conversion factor is as follows:

1 ppb = 2.62 micrograms per cubic metre (for SO_2 only)

- at a temperature of 25°C and 1013 mb pressure.

1 ppb = 2.66 micrograms per cubic metre (for SO_2 only)

- at a temperature of 20°C and 1013 mb pressure.

The conversion factor is different for other gaseous pollutants.

Appendix 2

Data Files for 2001

Data Files

The full year's dataset, for all Network sites, is supplied on the same CD as this report (or for printed copies, on the disk inside the back cover). The data are presented in **comma separated value** (CSV) format, a form which can be read into most spreadsheets. The data are provided in several files;

1. file "site2001": a summary of site details. The data are tabulated in rows, one per site, with columns as follows.

- Site code - the site's unique identification number of upto 7 digits.
- Site name and number - the name and number by which the site is usually known, eg. "ABERDEEN 3".
- Grid reference easting, given to the nearest 100m.
- Grid reference northing, given to the nearest 100m. Note; for sites in Northern Ireland the grid reference refers to the Irish Grid, and both the easting and northing are preceded by a "9" to indicate this.
- Site address.
- Site Environment. The surroundings of each site are classified by a code according to the following scheme:

- A1 Residential area with high-density housing (probably terraced), or with medium-density housing in multiple occupation, in either case surrounded by other built-up areas.
- A2 Predominantly A1, but interspersed with some industrial undertakings.
- A3 Residential area with high-density housing or medium-density housing in multiple occupation surrounded by, or interspersed with, other areas with low potential air pollution output (parks, fields, coast).
- B1 Residential area with medium-density housing, typically an inner suburb or housing estate, surrounded by other built-up areas.
- B2 Predominantly B1, but interspersed with some industrial undertakings.
- B3 Residential area with medium-density housing surrounded by or interspersed with areas with low potential air pollution output (parks, fields, coast), or any residential area with low-density housing.
- C1 Industrial area without domestic premises.
- C2 Industrial area interspersed with domestic premises of high density or in multiple occupation.
- D1 Commercial area or one with predominantly central heating.
- D2 Town centre with limited commercial area, possibly mixed with old residential housing and/or minor industry.
- E Smoke control area or smokeless zone (the letter to be added to the primary classification).
- R Rural community.
- O1 Open country but not entirely without source(s) of pollution, e.g. airfields.
- O2 Completely open country; no sources within at least 400 metres.
- X Unclassified site, or mixed area.

- Equivalent Defra Site Type. The Smoke and SO₂ Network site classifications differ considerably from those used by Defra to categorise their automatic sites. However, the nearest equivalent is given here. Smoke and SO₂ sites of types A1, A2, and A3 will mostly fall into Defra site types Suburban (SU) or Urban Background (U4), being predominantly in urban residential areas. B1, B2 and B3 will be Suburban (SU). C1 and C2 will be roughly equivalent to Urban Industrial (U5), and D1 and D2 Urban Centre (U3) or Urban Background (U4). R, O1 and O2 sites can all be treated as Rural (R).
- Unitary Authority. The name of the Local or Unitary Authority in whose area the site lies. In most cases this Authority is responsible for the operation of the site, although a small number of sites are operated by other organisations such as universities.
- Government Region Code. The twelve regions are assigned code numbers from 1 to 12.
- Government Region Name.
- County name. The name of the county in which the site lies.

2. file "smk2001": full daily black smoke data, 1st January to 31st December 2001, for all sites. One column per site, with one row per day. Values are in $\mu\text{g m}^{-3}$. Black smoke concentrations have been calculated according to the British Standard calibration, as used in the UK. For communications with organisations elsewhere in Europe, the concentrations should be converted to the OECD calibration, by dividing by 0.85

3. file "so22001": full daily sulphur dioxide data, 1st January to 31st December 2001, for all sites. One column per site, with one row per day. Values are in $\mu\text{g m}^{-3}$.

4. file "smksumm2001": this contains the smoke summary data as in Table 1, but in CSV format. The data are tabulated as follows. The top row contains column headings.

- Site code number
- Site name.
- Region name (e.g. North East).
- Local or Unitary Authority in whose area the site lies.
- Grid reference easting.
- Grid reference northing.
- Number of valid days' smoke data
- Data capture expressed as a percentage
- Arithmetic mean of daily smoke measurements
- Median (50th percentile) of daily smoke measurements
- 98th percentile of daily smoke measurements
- Maximum daily value.

There is one row of data per site, and they are presented by region.

5. file "so2summ2001": this contains the SO₂ summary data as in Table 1, but in CSV format. The data are tabulated in the same manner as the smoke data in "smksumm2001.csv" described above. Again, the top row contains column headings. All these details are also given in the text file "readme.txt" which is also provided on disk.

Appendix 3

Sites Comprising “Core” Subset

10003	ABERDEEN 3
20005	ACCRINGTON 5
40004	ALFRETON 4
69701	ARMAGH 1
85005	ASHINGTON 5
90008	ASHTON-UNDER-LYNE 8
150005	BACUP 5
160003	BALLYMENA 3
190012	BARNESLEY 12
190013	BARNESLEY 13
205006	BATH 6
240010	BEDFORD 10
270013	BELFAST 13
270042	BELFAST 42
270046	BELFAST 46
380006	BLACKPOOL 6
390302	BLETCHLEY 2
395005	BOLSOVER 5
400024	BOLTON 24
430006	BRADFORD 6
453003	BRIDGWATER 3
470026	BRISTOL 26
500012	BURNLEY 12
507513	BURTON-UPON-TRENT 13
510009	BURY 9
540012	CARDIFF 12
555014	CARLISLE 14
580011	CASTLEFORD 11
625006	CHEADLE & GATLEY 6
715006	CHORLEY 6
750005	COALVILLE 5
760011	COATBRIDGE 11
840009	CREWE 9
855003	CROSBY 3
915013	DARLINGTON 13
960024	DERBY 24
995002	DUDLEY 2
1025001	DUNGANNON 1
1032503	DUNMURRY 3
1060007	EALING 7
1080005	EASTBOURNE 5
1100025	EDINBURGH 25
1130012	ELLESMERE PORT 12
1140014	ENFIELD 14
1230008	FARNWORTH 8
1290010	GATESHEAD 10
1300020	GLASGOW 20
1300051	GLASGOW 51

1300073	GLASGOW 73
1300095	GLASGOW 95
1300098	GLASGOW 98
1305004	GLOUCESTER 4
1305301	GLYNNEATH 1
1343709	GREENWICH 9
1360016	HALIFAX 16
1450003	HEMSWORTH 3
1515005	HOLMFIRTH 5
1550001	HORWICH 1
1570019	HUDDERSFIELD 19
1590006	ILFORD 6
1650011	KEIGHLEY 11
1690019	KINGSTON-UPON-HULL 19
1757703	LARNE 3
1790019	LEICESTER 19
1800004	LEIGH 4
1840005	LINCOLN 5
1845003	LISBURN 3
1950016	LONDON CITY 16
2190012	LONDONDERRY 12
2232507	MACCLESFIELD 7
2270002	MALTBY 2
2280011	MANCHESTER 11
2280015	MANCHESTER 15
2280021	MANCHESTER 21
2281010	MANSFIELD 10
2320003	MIDDLETON 3
2370002	NEWBURN 2
2370003	NEWBURN 3
2390024	NEWCASTLE UPON TYNE 24
2390027	NEWCASTLE UPON TYNE 27
2400026	NEWPORT (MON) 26
2410003	NEWRY 3
2412501	NEWTOWNABBEY 1
2412502	NEWTOWNABBEY 2
2430007	NORWICH 7
2440020	NOTTINGHAM 20
2470013	OLDHAM 13
2533510	PONTEFRACT 10
2551504	PORTADOWN 4
2560010	PORTSMOUTH 10
2650007	RAWTENSTALL 7
2677503	RETFORD 3
2752503	ROWLEY REGIS 3
2781510	RUNCORN 10
2800036	ST HELENS 36
2800043	ST HELENS 43
2839001	SCARBOROUGH 1

2870005	SEDGLEY 5
2872505	SELBY 5
2940016	SLOUGH 16
3070005	STIRLING (BURGH) 5
3090020	STOKE-ON-TRENT 20
3170008	SUNDERLAND 8
3220002	SWINDON 2
3265013	THURROCK 13
3314601	TRAFFORD 1
3350026	WAKEFIELD 26
3380018	WALSALL 18
3430017	WARRINGTON 17
3470002	WEDNESFIELD 2
3532002	WEST KIRBY 2
3541517	WESTMINSTER 17
3610008	WIGAN 8
3696009	WOOLWICH 9
3700003	WORKINGTON 3
3710012	WORKSOP 12
3732510	WREXHAM 10
3750009	YORK 9