Projecting and mapping carbon monoxide concentrations in support of the Air Quality Strategy review

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

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Executive Summary

The Air Quality Strategy for England, Wales, Scotland and Northern Ireland (AQS, DETR et al 2000) sets a specific objective for carbon monoxide to be achieved by 2003:

11.6 mgm^{-3} (10 ppm), measured as a running 8-hour mean

A review of the AQS is underway, aimed at reassessing the objectives set, in the light of new technical information and recent Government and European policies and Directives.

The recently adopted second European Daughter Directive on air quality, European Directive 2000/69/EC relating to limit values for benzene and carbon monoxide (AQDD2) prescribes the following limit value for carbon monoxide to be achieved by 2005:

10 mgm^{-3} (8.6 ppm), measured as a maximum daily 8-hour mean

Site-specific analysis techniques and high resolution mapping approaches have been used to assess concentrations for a recent and future years. Approaches have been updated with the latest pollutant models and information from the National Atmospheric Emissions Inventory (NAEI) incorporating the 10-Year Plan for Transport (DETR, 2000a) in pollutant projections.

Site-specific projections of roadside and urban background maximum 8-hour mean carbon monoxide concentrations for a number of sites in the Automatic Urban Network (AUN) have been performed for two base years to represent adverse and normal meteorological conditions (1997 and 1999 respectively). Estimates indicate that concentrations of carbon monoxide are likely to be well below both the AQS objective and AQDD2 limit value by the end of 2005.

Results from the site-specific analyses are confirmed by high resolution mapping using 1999 as a base year. Highest modelled urban background and roadside maximum 8-hour mean carbon monoxide concentrations in 1999 are estimated to be 6.3 and 13.8 mgm^{-3} respectively. Road links exceeding 10 mgm^{-3} are confined to London. Projecting these concentrations forward to 2005, it is estimated that all road links in the UK will meet the AQDD2 limit value.

From the site specific analyses, it is estimated that the AQS objective and AQDD2 limit value were met by the mid to late 1990s, even at two of the most heavily trafficked and roadside monitoring locations in the UK (Marylebone Road and Cromwell Road). For the Cromwell Road site, projections were also calculated using the 1991 base year, to represent projected concentrations for a 'worst-case' atmospheric dispersion scenario and indicate that even when constrained by these conditions projected concentrations are estimated to meet the AQS objective and AQDD2 limit value by 2000. From the mapping analysis, the highest roadside maximum 8-hour carbon monoxide concentration has been identified (13.8 mgm^{-3}). Projecting this modelled concentration for 1999 forwards, the concentration for this road in 2003 is estimated to be 10.3 mgm^{-3} indicating that widespread exceedence of 10 mgm^{-3} as a maximum 8-hour mean carbon monoxide concentration in London and elsewhere in the UK is unlikely by this date.

Contents

1 Introduction

This report describes the modelling methods that have been used to predict carbon monoxide concentrations across the UK. The work forms part of a review of the Air Quality Strategy for England, Wales, Scotland and Northern Ireland (AQS, DETR et al 2000) by the Department for Food Environment and Rural Affairs, the Scottish Executive, the National Assembly for Wales and the Department of the Environment Northern Ireland. The review is aimed at reassessing the objectives laid out in the AQS in the light of new technical information and recent Government and European policies and Directives.

The current AQS gives the following objective for carbon monoxide to be achieved by the end of 2003:

- Maximum running 8-hour mean of 11.6 mgm^{-3} (10 ppm)

The recently adopted second European Daughter Directive on air quality, European Directive 2000/69/EC relating to limit values for benzene and carbon monoxide (AQDD2) prescribes the following limit value for carbon monoxide to be achieved by 2005:

- Maximum daily 8-hour mean of 10 mgm^{-3} (8.6 ppm)

The following sections outline the methods used in the site-specific analysis of carbon monoxide concentrations and high resolution mapping techniques used to assess concentrations at the current time and for futures years. Site-specific modelling and mapping approaches have been updated with the latest pollutant models and information from the National Atmospheric Emissions Inventory (NAEI) incorporating the 10 Year Plan for Transport (DETR, 2000a) in future pollutant projections.

2 Baseline emissions inventory

Emission inventory maps for 1998 at a 1 km x 1 km resolution from the NAEI have been used throughout the work presented here (Goodwin et al, 2000). Maps of area emissions for the following sectors have been calculated:

- Domestic
- Industry
- Road Transport
- Other

Emissions maps for 1999 and 2005 have been calculated by scaling the sector maps from the 1998 NAEI with the changes in the UK sectors totals from the 1998 NAEI (for the years 1990-1999) and emissions projections (2000 onwards) from the 1998 NAEI. As the dominant source

of carbon monoxide in the UK is road transport, accounting for 69% of total emissions in the UK (DEFRA, 2001), emissions and projections for this sector have been recalculated based on the approaches to be used in the 1999 NAEI. In applying the effects of the 10-Year Plan for Transport to projected road transport emissions, the plan has been distributed evenly throughout England. In the long-term, this approach is likely to lead to an underestimation of the impacts of the 10-Year Plan particularly in London and other conurbations where this policy is expected to have greatest effect. However, over the timescale of this study estimates of emissions are unlikely to be significantly effected, as the 10-Year Plan is not anticipated to have a substantial impact upon emissions until after 2005. Hence, this simplified modelling approach is justified.

3 Site-specific projections of carbon monoxide concentrations

3.1 METHOD

The method used to calculate site-specific projections of maximum 8-hour mean carbon monoxide concentrations was first implemented for the calculation of NO_2 and PM10 projections and is described in the AQS (DETR et al, 2000) and in some detail by Stedman et al (1998a) and Stedman (1999). The method has subsequently been revised and updated for carbon monoxide to incorporate:

1. More up-to-date monitoring information.
2. More detailed emission inventory using:

    - *1990-1999 historical data from the 1998 NAEI for stationary sources*
    - *Projections to 2025 from the 1998 NAEI for stationary sources*
    - *Road transport historical emissions and projections updated to the 1999 NAEI methodology*

The projections are based on measurements carried out at sites within the national automatic monitoring networks (see www.aeat.co.uk/netcen/airqual for details of the site locations and an archive of monitoring results). The following steps were required to project measured concentrations, and are carried out using the current baseline emissions scenario:

1. The measured carbon monoxide concentrations were divided into component parts. Local source contributions were defined using the 1998 emission inventory maps for various sectors (Goodwin et al, 2000). Local sources were summed within a 35 km x 35 km area centred on the monitoring site location. An ADMS based dispersion matrix was applied to weight emissions from individual grid cells according to distance and direction from the site location. This dispersion matrix approach was also used to calculate the maps and is described in sections 4. It was assumed that the rural background contribution to the running 8-hour mean carbon monoxide concentration was negligible and set to zero.

2. An additional contribution from emissions on the road adjacent to the monitoring site was included for roadside monitoring sites. Maximum 8-hour mean projections at these locations contained contributions from the projected road traffic component only.
3. Each component was then projected forwards from the measurement year through to 2025, according to the projected change in emissions from each sector and added together to give an estimate of maximum 8-hour mean carbon monoxide concentrations.

Figures 1 to 4 present illustrative examples of site-specific projections of carbon monoxide concentrations for years between 1990 and 2025. Projected concentrations have been calculated from measured concentrations in a number of base years in order to show the effect of varying dispersion characteristics. Nominally, the base years selected were 1997, representing poor dispersion characteristics and 1999, representing normal dispersion characteristics. In cases where monitoring data for these years is unavailable, alternative years have been selected. There is reasonable agreement between the projections for the years in the early 1990s and the measured concentrations, giving confidence in the emissions sector split and emissions estimates.

Figures 1 to 4 indicate that the AQS objective and AQDD2 Limit Value were met by the early to mid-1990s at both urban background and roadside locations.

Figure 1 Projected maximum 8-hour mean carbon monoxide concentrations at Glasgow City Chambers based on 1997 and 1999 monitoring data

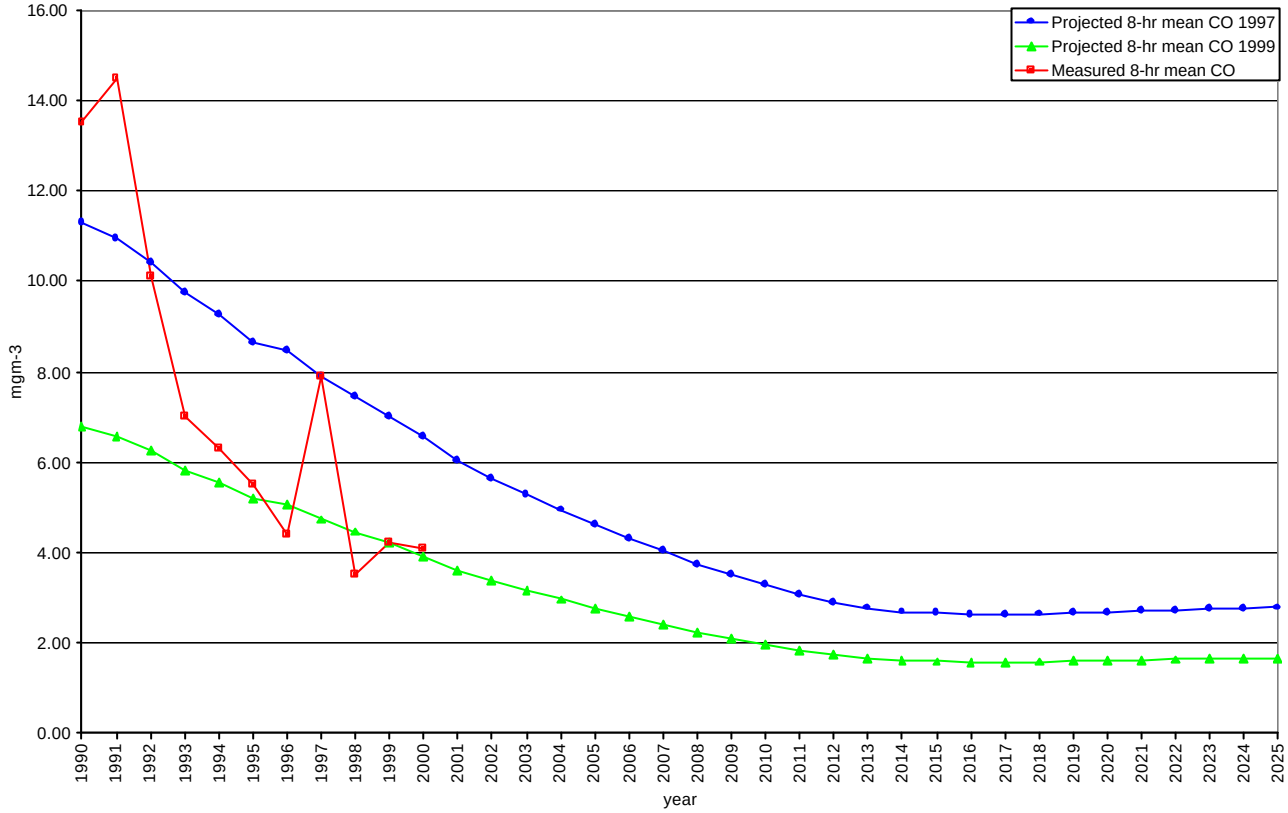


Figure 2 Projected maximum 8-hour mean carbon monoxide concentrations at Cardiff Centre based on 1997 and 1999 monitoring data

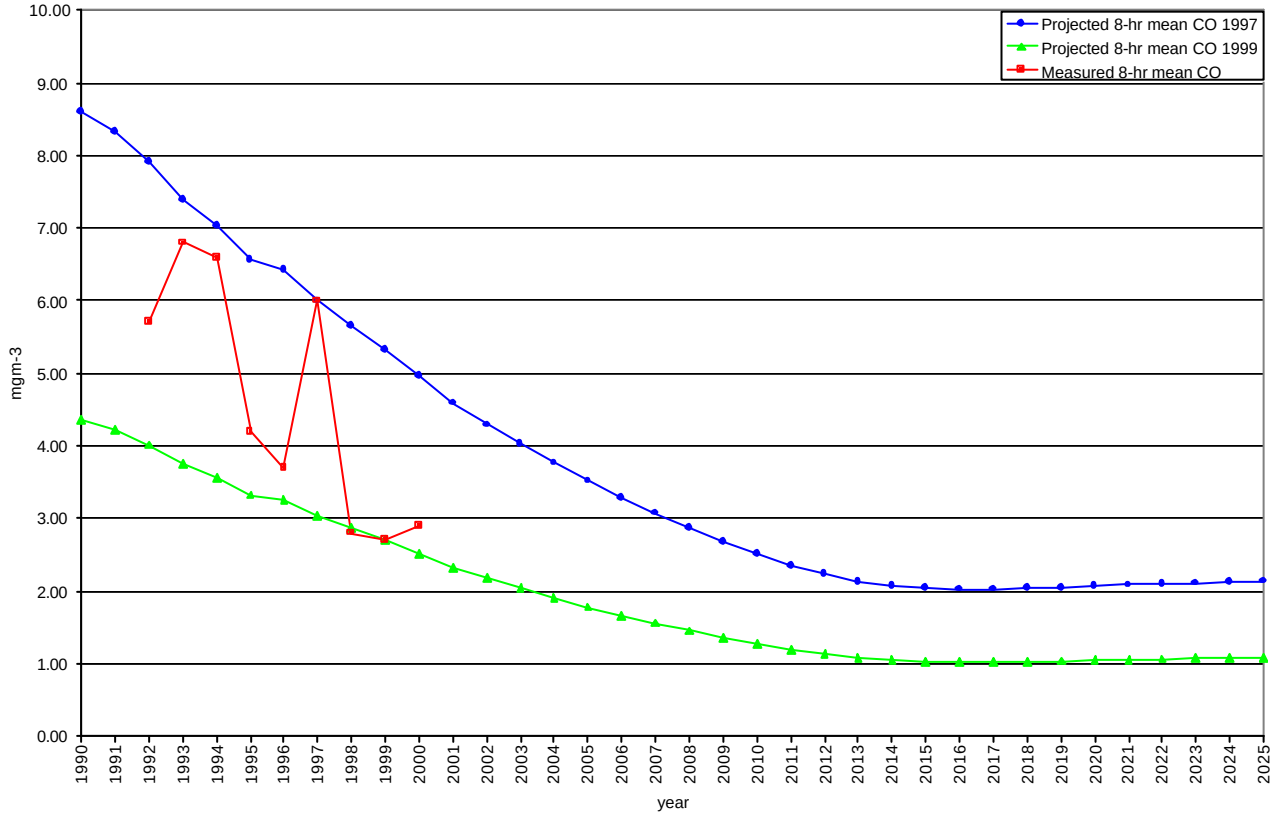


Figure 3 Projected maximum 8 hour mean carbon monoxide concentrations at Marylebone Road based on 1998 and 1999 monitoring data

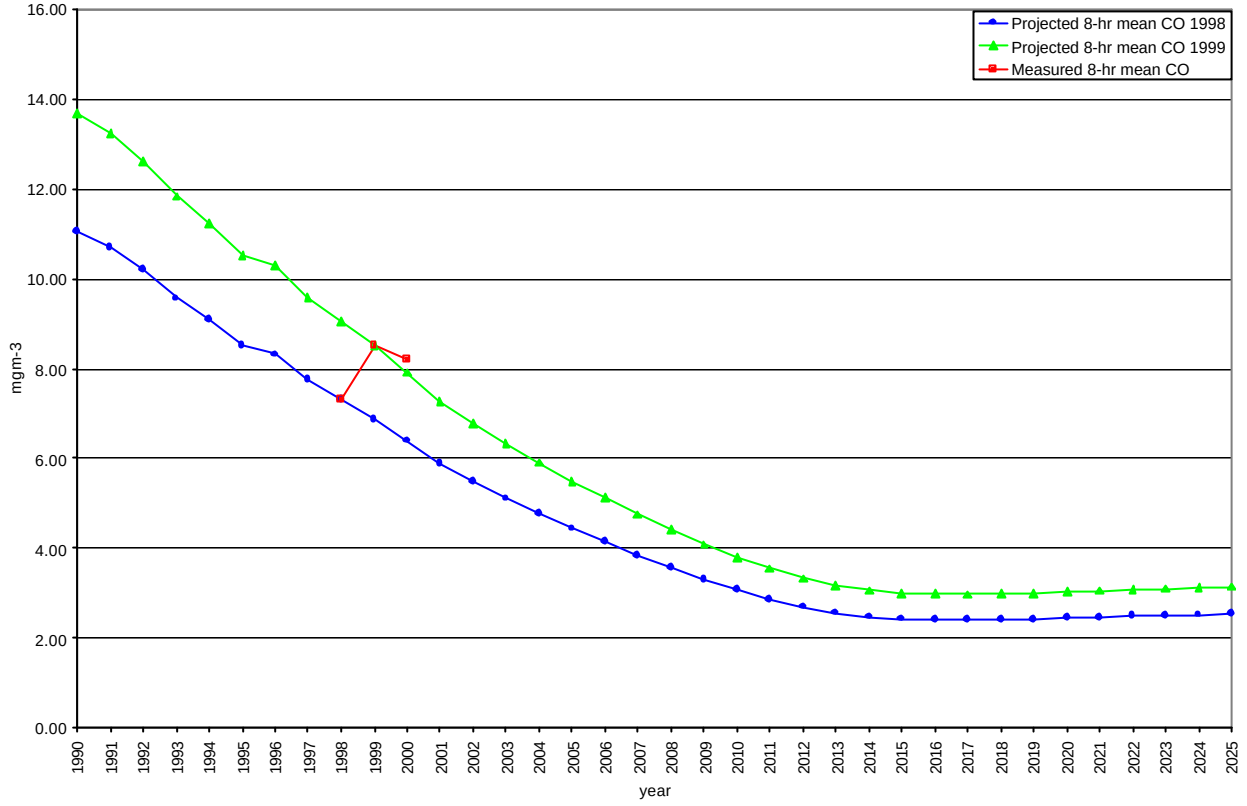
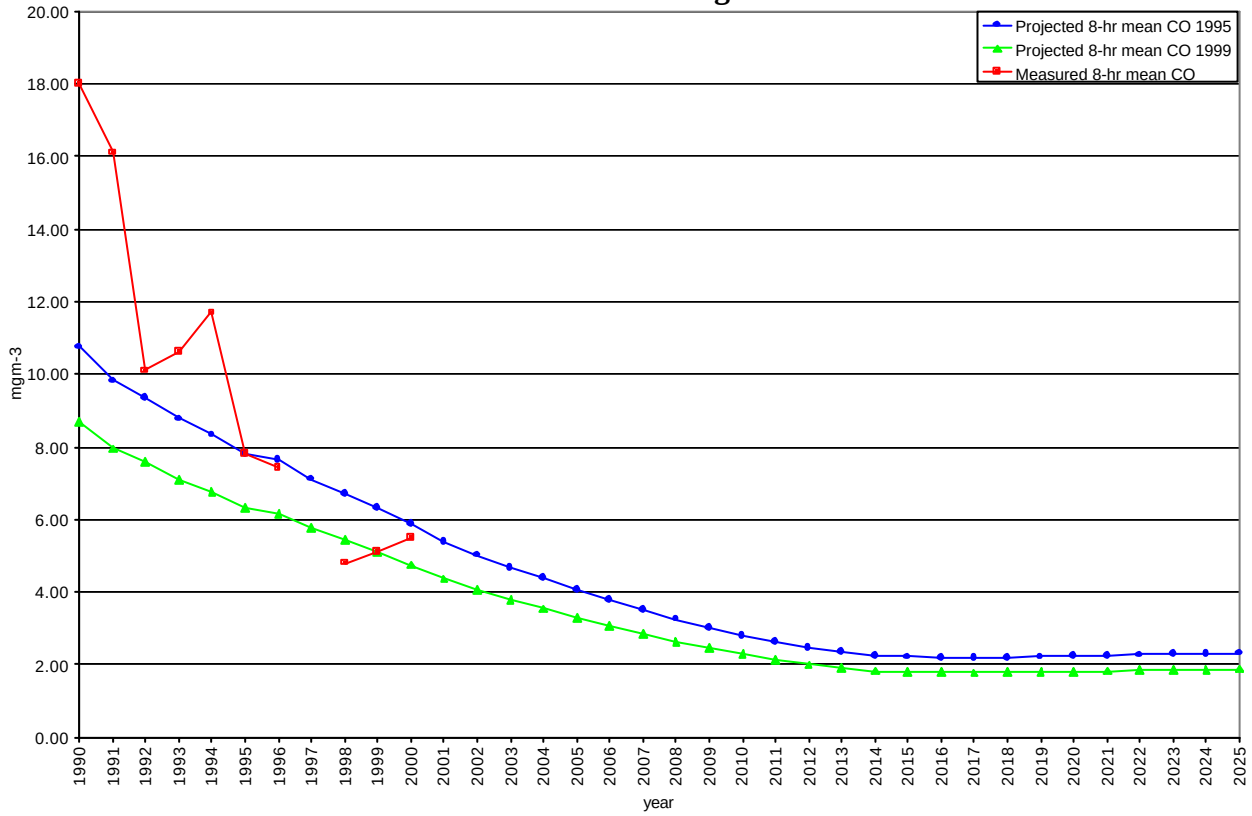


Figure 4 Projected maximum 8-hour mean carbon monoxide concentrations at Cromwell Road based on 1995 and 1999 monitoring data



3.2 MEASURED CONCENTRATIONS 1997 AND 1999

Measured maximum 8-hour mean carbon monoxide concentrations for the 1997 and 1999 base years are listed in Table 1 for the sites for which site-specific projections have been calculated. Blank entries in the table indicate the absence of monitoring data for that year.

Table 1 Measured maximum 8-hour mean carbon monoxide concentrations 1997 and 1999 (mgm^{-3})

	Measured max 8 hour mean (mgm^{-3})	
	1997	**1999**
Bridge Place	8.20	3.94
Cardiff Centre	6.00	3.04
Edinburgh Centre	2.90	1.91
Glasgow City Chambers	7.90	4.73
West London	9.30	4.83
Cromwell Road		5.75
Exeter Roadside	13.90	6.77
Glasgow Roadside	9.60	4.96
Marylebone Road		9.59
Sutton Roadside	12.10	4.85
Tower Hamlets Roadside	11.50	7.33

Table 1 shows that the measured maximum 8-hour mean carbon monoxide concentration at urban background location is consistently below the AQS objective and the AQDD2 limit value. Measurements at the all roadside location in 1997 (a year of relatively poor dispersion) were greater than or very close to the AQS objective and the AQDD2 limit value. In the 1999 calendar year, which experienced more normal atmospheric dispersion characteristics, all roadside sites measured concentrations below the AQS objective and the AQDD2 limit value.

3.3 BASELINE PROJECTIONS FOR 2005

Projected carbon monoxide concentrations for 2005 (using 1997 and 1999 base years) are presented in Table 2. A blank entry in the tables indicates that projections could not be performed owing to the absence of monitoring data for that year.

Table 2 Maximum 8-hour mean carbon monoxide projections to 2005 based upon 1997 and 1998 base years

	Estimated max 8 hour mean carbon monoxide 2005 (mgm^{-3})	
	1997 base year	**1999 base year**
Bridge Place	4.81	2.31
Cardiff Centre	3.52	1.78
Edinburgh Centre	1.71	1.13
Glasgow City Chambers	4.62	2.76
West London	5.47	2.85
Cromwell Road		3.29
Exeter Roadside	7.96	3.88
Glasgow Roadside	5.49	2.84
Marylebone Road		5.49
Sutton Roadside	6.93	2.78
Tower Hamlets Roadside	6.58	4.20

Table 2 indicates that by 2005, maximum 8-hour mean carbon monoxide concentrations will be substantially lower than the AQS objective and AQDD2 limit value, even at heavily trafficked roadside locations and applying projections from a base year with adverse dispersion characteristic (1997).

4 Maps of carbon monoxide concentrations

4.1 METHOD FOR MAPS OF BACKGROUND CONCENTRATIONS

The methods used to calculate maps of background carbon monoxide concentrations have been developed over a number of years and are described in detail in a number of reports and papers including Stedman et al (1997), Stedman (1998), Stedman et al (2001a), Stedman and Linehan (1999) and Stedman and Bush (2000). These methods have been continually revised and updated to incorporate more up-to-date monitoring data, emission inventory data and projection information. This section briefly summarises the methods used.

Measured urban background maximum 8-hour mean carbon monoxide concentrations have been assumed to be derived entirely from emissions from local sources. A regression analysis was performed to find the coefficient, k_b, for the relationship between the measured maximum 8-hour mean and estimated carbon monoxide emissions in the vicinity of the monitoring sites taken from the NAEI (Goodwin et al 2000):

$$\textit{Maximum 8-hour mean carbon monoxide} = k_b.\textit{emissions}$$

This coefficient, which is the equivalent of an empirical box model coefficient, can then be used to derive a map of maximum 8-hour mean concentrations from emissions inventory estimates. Thus, automatic monitoring data are used to calibrate the relationship between ambient air quality and emissions inventories.

In earlier work on the estimation of air pollutant concentrations from emission related parameters (Stedman et al, 1997), the spatial scale at which local emissions seem to influence ambient air quality was investigated. It was found that estimates of emissions in an area of 25 km^2 centred on a background monitoring site provide the most robust relationships. In subsequent work incorporating improved spatially resolved emission inventories and more extensive monitoring data it became clear that contributions from outside the 25 km^2 area should be included. This is particularly important for large urban areas such as London, where an empirically derived 'out of square' contribution was added for inner London (Stedman et al, 2001a, Stedman and Bush 2000).

This has been addressed in the current work by including contributions to ambient concentrations from emissions in an area of 1225 km^2, with the contribution weighted by distance and direction from the central receptor. We have adapted an ADMS based approach described by Abbott and Vincent (1999) and others. The ADMS dispersion model was used to

calculate the contribution to concentrations at a receptor point from a 35 x 35 km hypothetical grid of 1 x 1 km cells of unit emission, grouped into blocks of 5 x 5 km. This level of spatial resolution was chosen to retain consistency with earlier work and avoid discontinuities in predicted concentrations at the borders of 1 x 1 km cells. Long period average meteorological data from Heathrow was used. The weighted sum of emissions around each monitoring site location was calculated and compared with the maximum 8-hour mean carbon monoxide concentration to derived the empirical dispersion coefficient k_b.

Estimated background carbon monoxide concentration (mgm^{-3}) = k_b. emissions (Tonnes carbon monoxide, weighted by distance and direction)

This revised method therefore, implicitly includes a contribution from 'out of square' emissions but the calibration of dispersion coefficients by automatic monitoring data is retained.

Area emissions maps were calculated for 1999 as described in section 2. Empirical dispersion coefficients were calculated by comparing emissions with automatic monitoring results. The meteorological conditions of the base year are, therefore, included in the dispersion coefficients and this should be the only difference between the coefficients for different years because the year to year changes in emissions have been accounted for.

Coefficients are listed in Table 3 for the relationship between the weighted sum of emissions and the local source contribution to ambient maximum 8-hour mean carbon monoxide concentration. Monitoring sites were found to fall into two groups: those in the large urban centres of Greater London, the West Midlands and Greater Manchester and those in the rest of the UK. The empirical dispersion coefficients were found to be lower in the large urban areas, presumably due to a combination of urban influences on local meteorology. This observation has been confirmed by dispersion modelling studies in London recently carried out by Abbott and Vincent (2001).

Table 3 Coefficients used to calculate background maximum 8-hour mean carbon monoxide maps (sm^{-1})

	Coefficient
Large urban areas	0.000207
Elsewhere in the UK	0.000395

Maps of estimated maximum 8-hour mean carbon monoxide concentrations were then calculated using the dispersion coefficient presented in Table 3 and area emission maps.

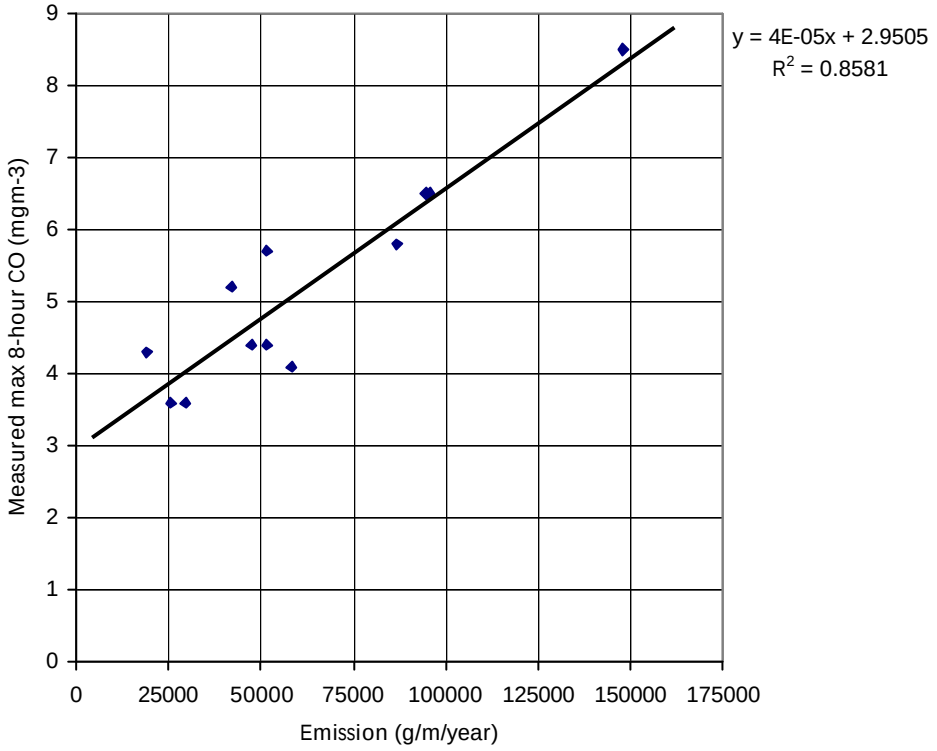
4.2 METHOD FOR MAPS OF ROADSIDE CONCENTRATIONS

It has been assumed that the maximum 8-hour mean carbon monoxide concentration at a roadside location is dominated by emissions from the adjacent road. The NAEI provides estimates of carbon monoxide emissions for a total of 14,075 major road links in the UK for 1998 (Goodwin et al, 2000). Figure 5 below, presents a comparison of the maximum 8-hour mean carbon monoxide concentrations at roadside or kerbside national automatic monitoring sites with carbon monoxide emission estimates for the individual road links, alongside which these sites are located. The sites chosen for this analysis are those for which emission estimates

are available that are in built-up areas. There is clearly a strong dependence of the roadside concentration upon carbon monoxide emission at these sites. The y-intercept is assumed to be the background component of maximum 8-hour mean carbon monoxide concentrations at the roadside.

Roadside maximum 8-hour mean carbon monoxide (mgm^{-3}) = k_r. emission from road link (g carbon monoxide m^{-1} y^{-1}) + 2.951

Figure 5 Comparison of maximum 8-hour mean carbon monoxide roadside concentration increment and road link carbon monoxide emission



The value of k_r for 1999 is listed in Table 4.

Table 4 Coefficients used to calculate the roadside maximum 8-hour mean carbon monoxide concentration (sm^{-2})

	1999
Coefficient	0.0000362

Roadside carbon monoxide monitoring sites at locations with a more open aspect, such as roads in rural areas, do not conform to this relationship. The carbon monoxide emissions from vehicles travelling on open aspect roads are generally more effectively dispersed than the emissions on built-up urban roads. We have therefore restricted our mapping to built-up major roads where the above relationship is reliable (7,180 A-road and motorway road links). Built-up motorway road links with speed limits of less than 70 mph were treated in the same way as other built-up major road links. Built-up motorway road links with speed limits of 70 mph were treated separately and the roadside increment was set to 0.225 of the value for other built-up major road links. This factor is based on the analysis of the limited monitoring data from sites

close to motorways with fast moving traffic, which indicates considerably enhanced dispersion in comparison with other roads in the urban environment.

Checks were made to ensure that estimated roadside carbon monoxide concentrations were not less than the local modelled background concentration. This, in general, occurred on minor A-roads in large conurbations with significant background concentrations compared with road link emissions. In such cases the road link concentration was set equal to the background concentration.

4.3 MAPS OF CONCENTRATIONS 1999

Maps of estimated maximum 8-hour mean carbon monoxide concentrations for 1999 at urban background and built-up major road links are shown in Figure 7 and 8 at the end of this section. Highest estimated concentrations are in the centres of the large cities. A scatter plot of estimated and measured maximum 8-hour mean carbon monoxide concentrations at roadside sites is shown in Figure 6. Summary statistics for the comparison of mapped and measured roadside concentrations are listed in Table 5. There is generally good agreement between the mapped and measured concentrations of carbon monoxide.

Figure 6 Measured and modelled maximum 8-hour mean carbon monoxide concentration at roadside sites 1999 (mgm^{-3})

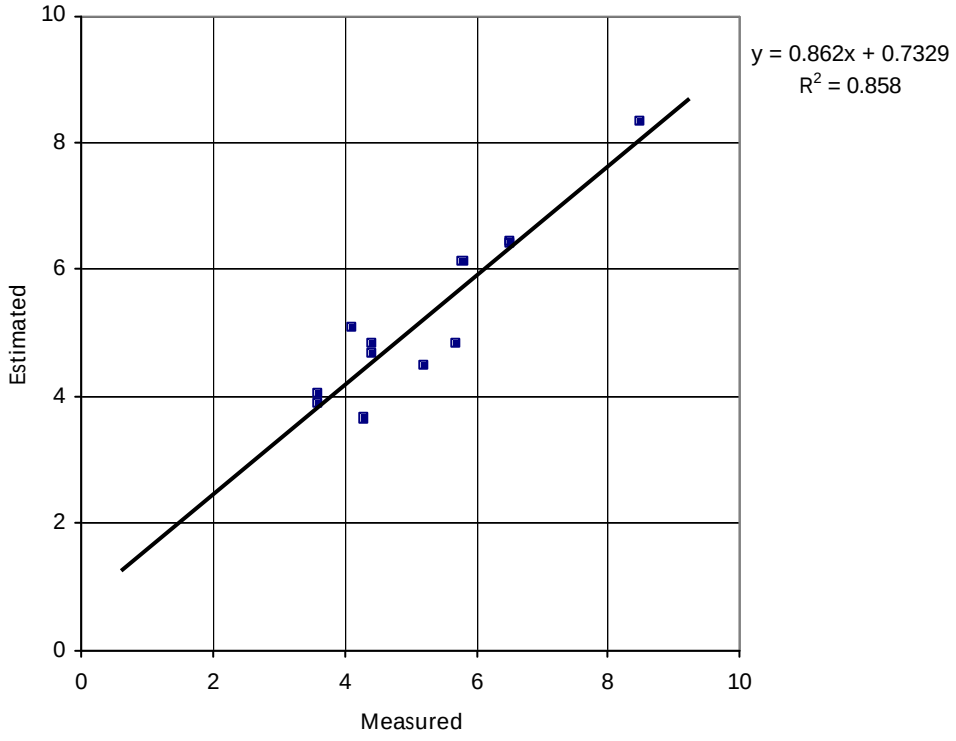


Table 5 Summary statistics for comparison of estimated and measured maximum 8-hour mean carbon monoxide concentration at roadside sites

	Mean of measurements (mgm^{-3})	Mean of model estimates (mgm^{-3})	r^2	Number of sites
Carbon monoxide, 1999	5.22	5.23	0.86	12

Highest background concentrations of carbon monoxide are to be found in inner London where the highest maximum 8-hour mean carbon monoxide concentration is estimated to be 6.3 mgm^{-3}. Highest roadside concentrations were also found in inner London where concentrations are estimated to reach 13.8 mgm^{-3} on the A4207.

Table 6 presents the number of road links with estimate maximum 8-hour mean carbon monoxide concentration greater than the 10 mgm^{-3} AQDD2 limit value. The numbers of roads exceeding a selection of lower concentration thresholds are also presented. The relevance of these thresholds is listed below.

10 mgm^{-3}: AQDD2 Limit Value for 2005
7 mgm^{-3}: AQDD2 Upper Assessment Threshold
5 mgm^{-3}: AQDD2 Lower Assessment Threshold

Table 6 Number of built-up major road links with estimated maximum 8-hour mean carbon monoxide concentration greater than or equal to AQDD assessment criteria, 1999

	No. road links with maximum 8-hour mean carbon monoxide [3]			Total road links in region
	5 mgm^{-3}	7 mgm^{-3}	10 mgm^{-3}	
Scotland	25	4	0	548
Wales	10	0	0	282
Northern Ireland	2	0	0	101
Inner London	583	91	14	760
Outer London	266	25	2	789
Rest of England	486	26	0	4700
TOTAL	1372	146	16	7180

Table 6 shows that for 1999, there is widespread exceedence of the Lower Assessment Threshold (LAT) throughout the UK and exceedence of the Upper Assessment Threshold (UAT) in all parts except Wales and Northern Ireland. Exceeded of 10 mgm^{-3} is limited to a number of roads in inner and outer London.

4.4 PROJECTED CONCENTRATIONS 2005

Maps of estimated maximum 8-hour mean carbon monoxide concentrations for 2005 at urban background and built-up major road links are presented in Figures 9 and 10. By 2005, it is estimated that the highest urban background maximum 8-hour mean carbon monoxide concentration will continue to be found in London (4.2 mgm^{-3}). At the roadside, highest concentrations are estimated to be on the A4207 where maximum 8-hour mean carbon monoxide is estimated to be 8.9 mgm^{-3}. Table 7 lists the number of road links with estimated maximum 8-hour mean carbon monoxide concentrations in 2005 greater than the AQDD2 limit value of 10 mgm^{-3} and other assessment criteria.

Table 7 Number of built-up major road links with estimated maximum 8-hour mean carbon monoxide concentration greater than or equal to AQDD assessment criteria, 2005

	No. road links with maximum 8-hour mean carbon monoxide [3]			Total road
	5 mgm^{-3}	7 mgm^{-3}	10 mgm^{-3}	links in region
Scotland	4	0	0	548
Wales	0	0	0	282
Northern Ireland	0	0	0	101
Inner London	50	6	0	760
Outer London	15	1	0	789
Rest of England	11	0	0	4700
TOTAL	80	7	0	7180

Table 7 shows that estimates of the number of road links with concentrations greater than the UAT and LAT will be significantly reduced. Exceedence of the AQDD2 Limit Value is estimated to have been eliminated by 2005

Figure 7 Estimated maximum 8-hour mean carbon monoxide concentrations at background and built-up major roads 1999 (mgm^{-3}). Ref NETCEN 18/04/2001, ~/naqs3tb/aq_objective/uk1com8h19991, rcom8h19991uk

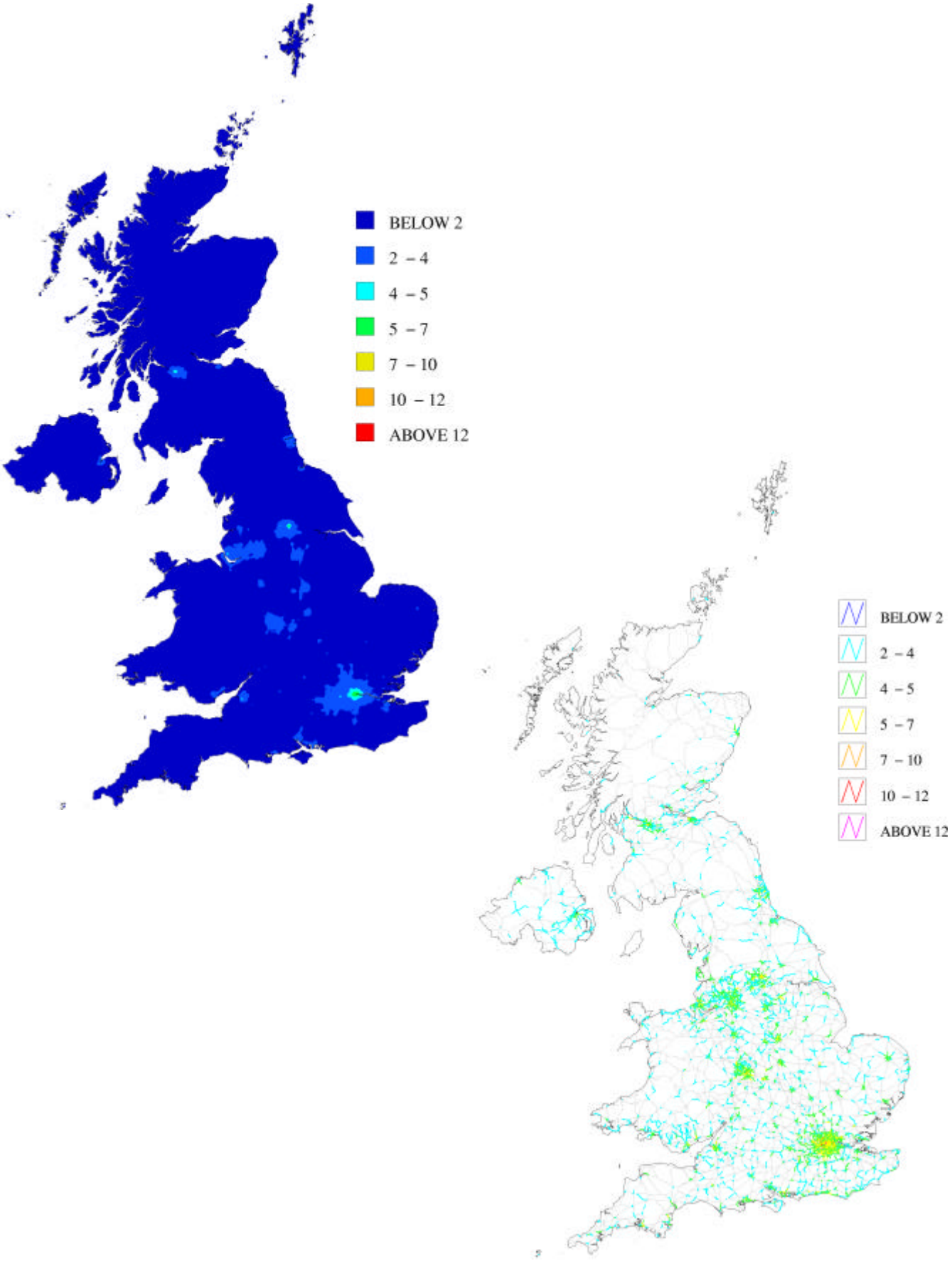
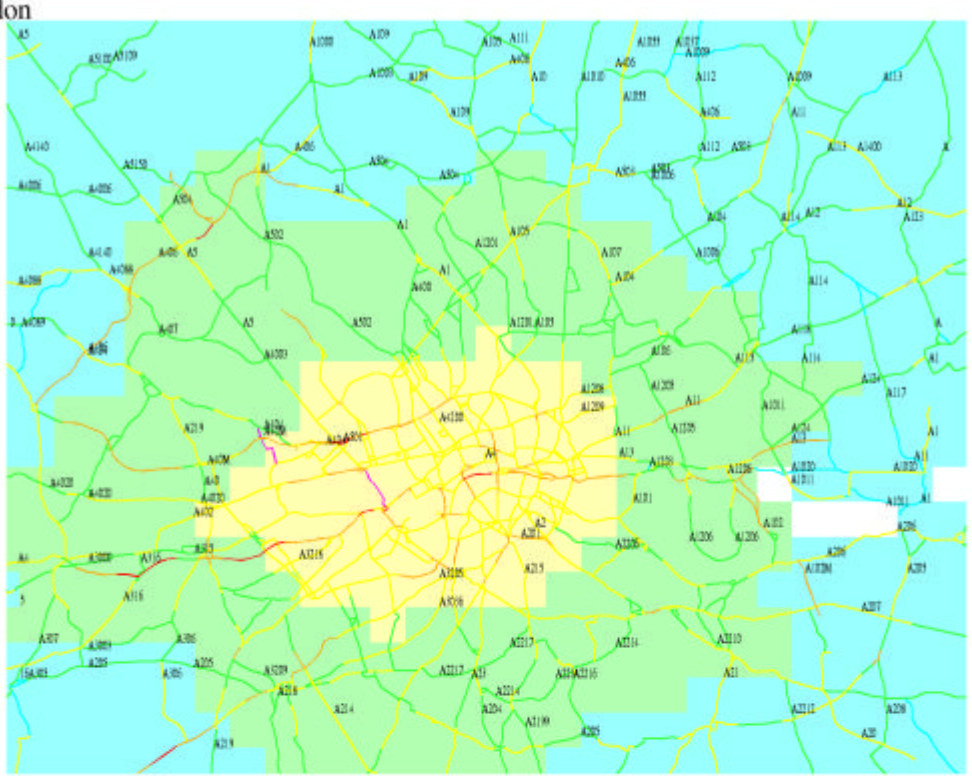


Figure 8 Estimated maximum 8-hour mean carbon monoxide concentrations in London, 1999 adjacent to major roads (mg/m^3).

London



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Central London

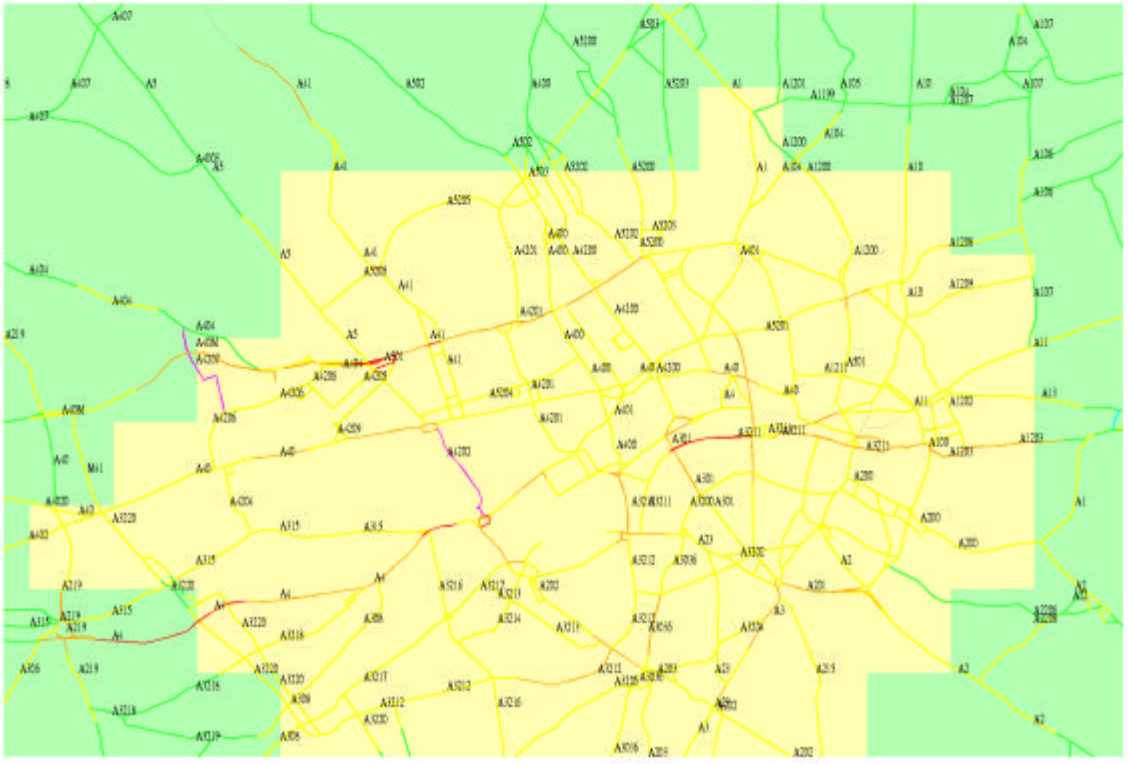


Figure 9 Estimated maximum 8-hour mean carbon monoxide concentrations at background and built-up major roads 2005 (mgm^{-3}). Ref NETCEN 18/04/2001, ~/naqs3tb/aq_objective/uk1com8h120051, rcom8h20051uk

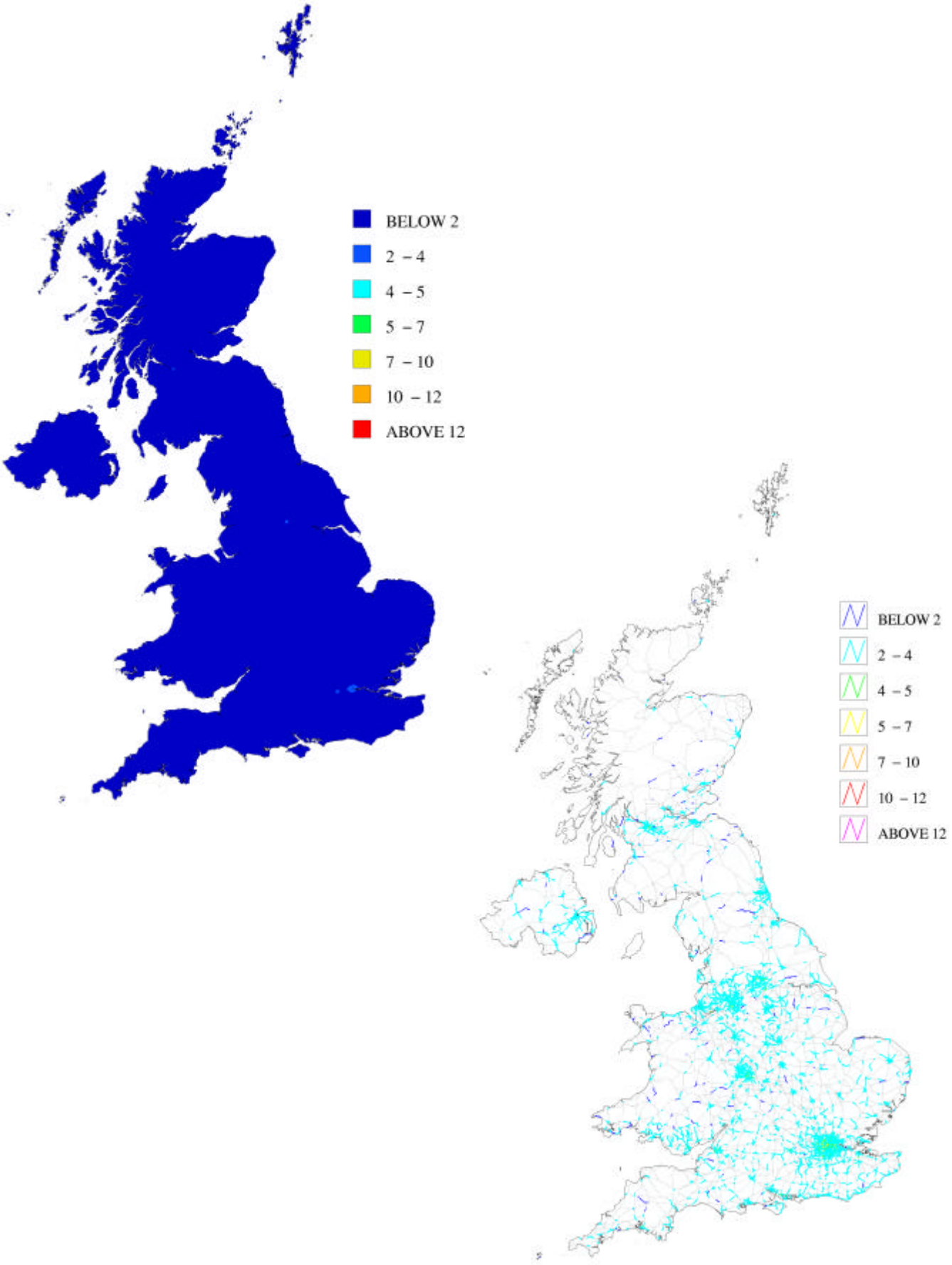
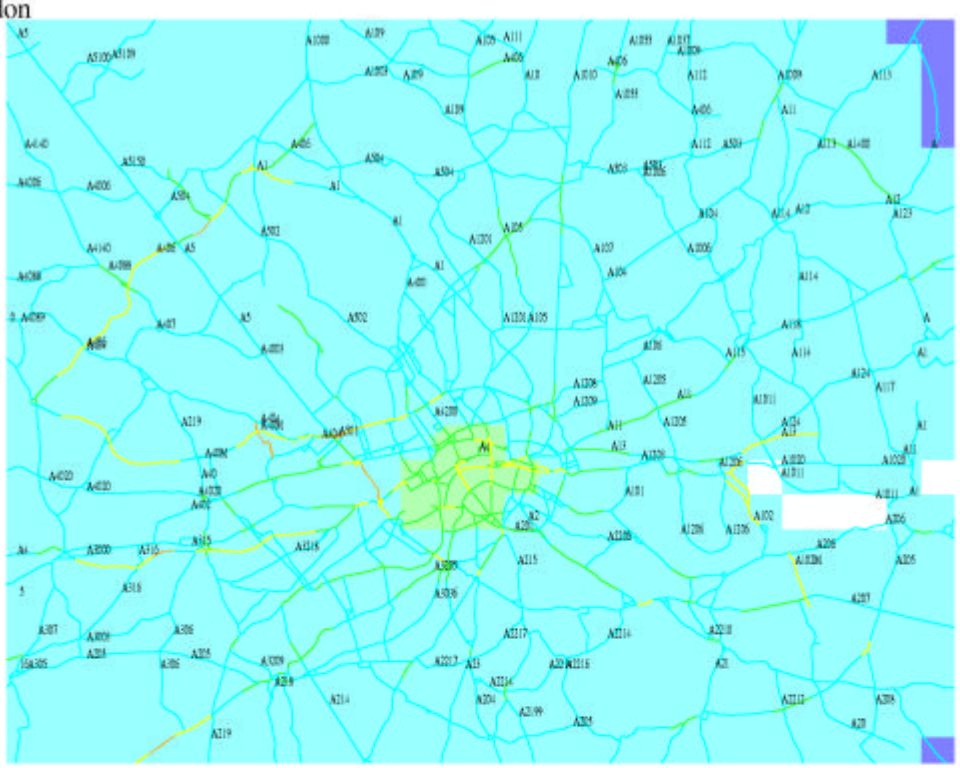


Figure 10 Estimated maximum 8-hour mean carbon monoxide concentrations in London, 2005 adjacent to major roads (mg/m^3).

London



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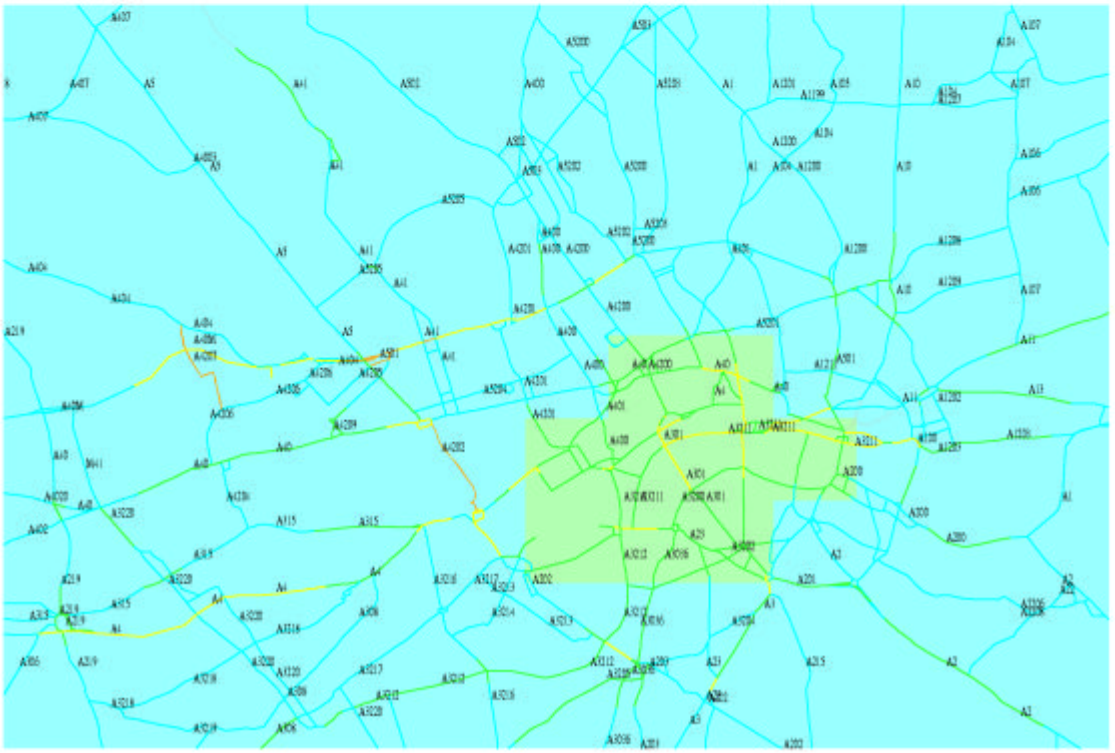
Central London



5 Discussion

Present day and projected carbon monoxide concentrations for 2005 are discussed in the following sections.

5.1 PRESENT DAY CARBON MONOXIDE CONCENTRATIONS

During 1999, all urban background and roadside monitoring locations measured maximum 8-hour mean carbon monoxide concentrations below both the AQS objective and AQDD2 limit value. The highest concentration was measured at the Marylebone Road roadside site (9.59 mgm^{-3}).

The site-specific modelling analyses presented in Table 1 have shown current measured carbon monoxide concentrations at urban background locations are consistently below the AQS objective for 2003 and AQDD2 limit value for 2005. This is true even for 1997 base year which is associated with unfavourable atmospheric dispersion characteristics. At roadside locations using 1997 meteorology most locations are observed to exceed the 10 mgm^{-3} AQDD2 limit value.

The results of the site-specific analyses at urban background locations are confirmed by those of the high resolution mapping. The highest modelled urban background maximum 8-hour mean carbon monoxide concentrations in 1999 is estimated to be 6.3 mgm^{-3}. At the roadside the highest maximum 8-hour mean is estimated to be 13.8 mgm^{-3}. Road links exceeding 10 mgm^{-3} are confined to London (see Table 6). Exceedence of the 5 mgm^{-3} LAT is widespread throughout the UK, as is exceedence of the 7 mgm^{-3} UAT in all areas except Wales and Northern Ireland.

5.2 PROJECTED BACKGROUND CARBON MONOXIDE CONCENTRATIONS, 2005

Estimated urban background maximum 8-hour mean carbon monoxide concentrations in 2005, projected using the site-specific technique were presented in Table 2. These projections show that for all monitoring locations carbon monoxide concentrations are estimated to be well below both the AQS objective and AQDD2 limit value irrespective of the atmospheric dispersion characteristics applied to this analysis. The highest projected urban background concentrations in 2005 are estimated to be 5.47 and 2.85 mgm^{-3} at West London using 1997 and 1999 base years respectively.

Using the high resolution mapping technique, the highest projected concentration in 2005 at a background location is estimated to be 4.2 μgm^{-3}.

5.3 PROJECTED ROADSIDE CARBON MONOXIDE CONCENTRATIONS 2005

Site specific projections for roadside locations in 2005 have shown that maximum 8-hour mean concentrations are estimated to be below the AQDD2 limit value. The highest projected concentration using the 1997 base year is estimated for the Exeter Roadside location (7.96 mgm^{-3}) and for the 1999 base year for the Marylebone Road location (5.49 mgm^{-3}).

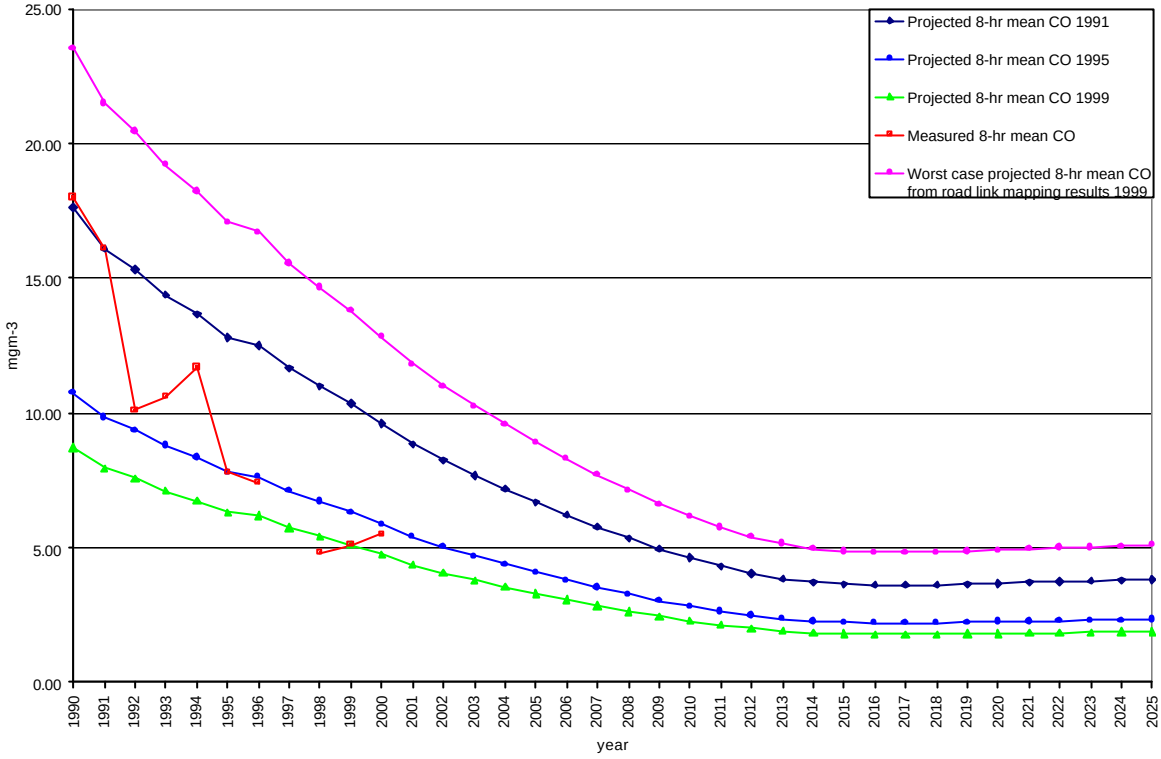
Projected concentrations for 2005 derived from the high resolution mapping technique indicate that all road links are likely to meet the AQDD2 limit value. Exceedence of the UAT is limited to London and the LAT to London, the Rest of England and 4 roads in Scotland.

5.4 EARLY IMPLEMENTATION OF THE AQDD2 LIMIT VALUE

From the site-specific analyses presented in Figures 3 and 4 (section 3.1) it has been shown that even for two of the most heavily trafficked roadside locations in the UK (Marylebone Road and Cromwell Road), the AQS objective and AQDD2 limit value were met by the mid to late 1990s. For the Cromwell Road site, projections were also calculated using the 1991 base year to represent projected concentrations for a 'worst-case' atmospheric dispersion scenario. Figure 9 below presents these projections and shows that even when constrained by these conditions projected concentrations are estimated to meet the AQS objective and AQDD2 limit value by 2000.

From the high resolution mapping analysis, the highest roadside maximum 8-hour mean carbon monoxide concentration in 1999 has been identified (13.8 mgm^{-3}). Projecting this modelled concentration forwards, the concentration for this road in 2003 is estimated to be 10.3 mgm^{-3}. This indicates that widespread exceedence of 10 mgm^{-3} as a maximum 8-hour mean carbon monoxide concentration in London and elsewhere in the UK is unlikely by this date.

Figure 9 Projected maximum 8-hour mean carbon monoxide concentrations at Cromwell Rd, based on 1991, 1995 and 1999 monitoring data and at the highest modelled road link 1999



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