General Details

Dataset Title:	Ambient Air Quality: Scores of Benzene Concentrations at Background and Roadside Locations, 2005
Domain(s):	Physical Environment; Indicators: Physical Environment
Time Period of Dataset(s):	01 January 2005 - 31 December 2005
Geographic Coverage:	England, Wales
Lowest Area Output:	Middle Layer Super Output Area (MSOA)
Supplier:	Department for Environment, Food and Rural Affairs (Defra)
Department:	Air and Environment Quality
National Statistics Data?	Not National Statistics - this information based on administrative data does not comply fully with the National Statistics Code of Practice.
No. of Variables (excluding area names and codes):	2

Scope and Purpose

Air pollution is a serious issue for health in the UK and the Government has made commitments to improve air quality. The Ministerial Foreword to 'The Air Quality Strategy in England, Scotland, Wales and Northern Ireland – Working Together for Clean Air' included the following statement: "Air pollution hits hardest the most vulnerable in our society. The old and the young, in particular those suffering from asthma and heart and lung diseases. It also tends to be worse in our heavily congested inner city areas where it exacerbates a poorer quality of life and increased social deprivation. Our commitment to delivering clean air is an important aspect of our wider policies to address social deprivation. That is why air pollution is one of the fifteen headline indicators of sustainable development."

Defra and the devolved administrations operate a national network of air quality monitors. Information from this network is used to help assess the effectiveness of existing policies and develop new ones. The UK's air quality monitoring networks also provide a substantial and accessible source of information on air quality. Monitoring information is published at www.airquality.co.uk.

This dataset is one of a set of five providing scores of concentrations a range of different air pollutants: nitrogen dioxide (NO_2), particulate matter (PM_{10}), sulphur dioxide (SO_2), benzene and ozone. Further datasets on emissions are also available on the Neighbourhood Statistics website, and cover: nitrogen oxide (NO_x), particulate matter (PM_{10}), sulphur dioxide (SO_2) and benzene.

This dataset provides scores of annual mean benzene concentrations for 2005 at background and roadside locations in the UK. The data are collected by Netcen on behalf of Defra and the Devolved Administrations. The scores in this dataset are calculated by comparing annual mean benzene concentrations for 2005 in MSOAs with the EPAQS Standard of 3.25 $\mu g/m^3$. The scores reported in this dataset are calculated from a modelled annual mean concentration (an average over the whole year) in micrograms per cubic metre ($\mu g/m^3$).

Benzene is a recognised genotoxic human carcinogen, meaning it causes cancers in humans. The National Air Quality Strategy for England, Scotland, Wales and Northern Ireland sets objectives for reducing the concentration of Benzene in the air to minimise the health risk to the population.

Benzene is a volatile organic compound. In the UK the main atmospheric source is the combustion and distribution of petrol, of which it is a minor constituent. Benzene is also formed during the combustion process from aromatics in the petrol.

Concentrations of air pollutants are measured at monitoring sites around the UK. The data presented here have been estimated using models in order to provide data for the whole of the country at small area levels. These models use information from emission inventories, which describe the amount of pollution emitted, and which use meteorological data to describe how the air pollutants are dispersed and transported in the air. The models have been developed to include an understanding of the physical and chemical processes taking place in the air.

The Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland includes objectives for levels of Benzene for the protection of human health. Limit Values for the protection of human health have also been set within the EU Air Quality Framework and Daughter Directives. Please see the Defra website for further information about the AQS.

The Policy Action Team (PAT) 18 report "Better Information" (April 2000) recognised the need to identify areas with poor air quality, while Neighbourhood Renewal policies have set standards in supporting environmental improvement and evaluating the impact of regeneration schemes. This dataset is a key link in aiming to achieve this.

Maps of average ambient air concentrations are calculated annually using dispersion models in order to supplement the measurement data available from ambient air quality monitoring sites. Maps of roadside concentrations are also calculated but this modelling is only applicable on urban (built-up) roads. Roadside concentration data are therefore not applicable in some MSOAs. Where available, the roadside information provides an indication of the differences between air pollution close to and away from the immediate vicinity of busy roads. To view the relevant maps for background and roadside concentrations, please see the 'Concepts and Definitions' section.

The mapped air quality concentration data are reported annually to the European Commission as required by EU Air Quality Framework and Daughter Directives. The data are also used in the development of UK air quality policy by Defra and the Devolved Administrations.

The information presented here firstly enables a comparison of ambient air pollutant concentrations in different places both within MSOA boundaries (background compared with roadside) and between MSOAs. Secondly it enables a comparison of these concentrations with recognised 'benchmark' concentrations.

Further datasets on emissions by MSOA are also available. These are complementary and provide an indication of the main sources of air pollution in a particular area. Some components of air pollutants can, however, travel over considerable distances (100s or even 1000s of km) so an analysis of local sources may not tell the whole story.

Administrative information on the location of local authority Air Quality Management Areas is also available in a separate dataset. Additional information on air pollution is available from measurement data at monitoring site locations on the Air Quality website.

Methodology - Background Information

Air pollution concentrations are estimated using air dispersion models which incorporate information including emission inventory estimates (including significant sources with a fixed location such as power stations and factories) and meteorological data. Measured data from air pollution monitoring sites are used to calibrate the models, while monitoring data from an independent set of sites are used to verify the model results. The modelled concentration at a particular location is subject to greater uncertainty than a concentration measured at an individual automatic monitoring station but the use of models enables data to be provided for the whole country.

Maps of ambient air concentrations at background locations are calculated by adding the contributions to concentrations from the different sources; regional rural concentrations are interpolated from measurements of air quality at rural sites. The contributions from point sources are modelled from

published emission inventory estimates from the National Atmospheric Emissions Inventory (NAEI) using an air dispersion model. The contributions from area sources (such as road traffic and domestic heating) are modelled from published emission inventory maps from the NAEI using an air dispersion model and then calibrated using data from automatic monitoring stations. Maps are calculated at a grid resolution of 1km x 1km. The scores for background concentrations reported in this dataset are calculated from the modelled annual mean concentrations (an average over the whole year) in micrograms per cubic metre ($\mu g/m^3$).

Maps of ambient air concentrations at roadside locations are calculated by adding a roadside increment to the modelled background concentration. The roadside increment is calculated using a model which is calibrated by relating concentrations measured at roadside automatic monitoring stations to road traffic emissions. Roadside concentrations are calculated for urban major roads (A roads and motorways) only.

The scores in this dataset are calculated by comparing annual mean benzene concentrations for 2005 in MSOAs with the EPAQS standard of 3.25 micrograms per cubic metre ($\mu g/m^3$). A score of 5 or higher represents an MSOA that has exceeded this standard. The following table shows the relationship between the scores in the data, the percentage of the EPAQS standard that this concentration represents and the actual concentration of benzene:

Score	Percentage of EPAQS standard	Benzene Concentration ($\mu g/m^3$)
1	0-25%	0-0.8125
2	25-50%	0.8125-1.625
3	50-75%	1.625-2.4375
4	75-100%	2.4375-3.25
5	100-125%	3.25-4.0625
6	125-150%	4.0625-4.875

EPAQS standard for benzene concentration = 3.25 $\mu g/m^3$

Concepts and Definitions

Benzene - a volatile organic compound. In the UK the main atmospheric source is the combustion and distribution of petrol, of which it is a minor constituent. Benzene is also formed during the combustion process from aromatics in petrol.

An **ambient air concentration** is the concentration of an air pollutant in outdoor air expressed as the mass of the pollutant per unit volume. Ambient air concentrations are measured routinely at a number of automatic air monitoring stations around the UK. There are 4 automatic monitoring sites measuring benzene on an hourly basis throughout the UK. There are also 23 pumped tube monitors which provide data on a fortnightly basis.

Background locations are defined as locations away from the immediate vicinity of a major road.

Roadside locations are defined as within approximately 5 - 10 metres from the edge of a major road (A-roads and motorways).

μg/m^3 - micrograms per cubic metre.

The **NAEI** is the UK **National Atmospheric Emission Inventory**. The NAEI is funded by Defra, The National Assembly for Wales, The Scottish Executive and The Department of Environment, Northern Ireland. The NAEI compiles estimates of emissions to the atmosphere from UK sources such as cars, trucks, power stations and industrial plants. Emissions are estimated to help find ways of reducing the impact of human activities on the environment and on our health. For more information see www.naei.org.uk.
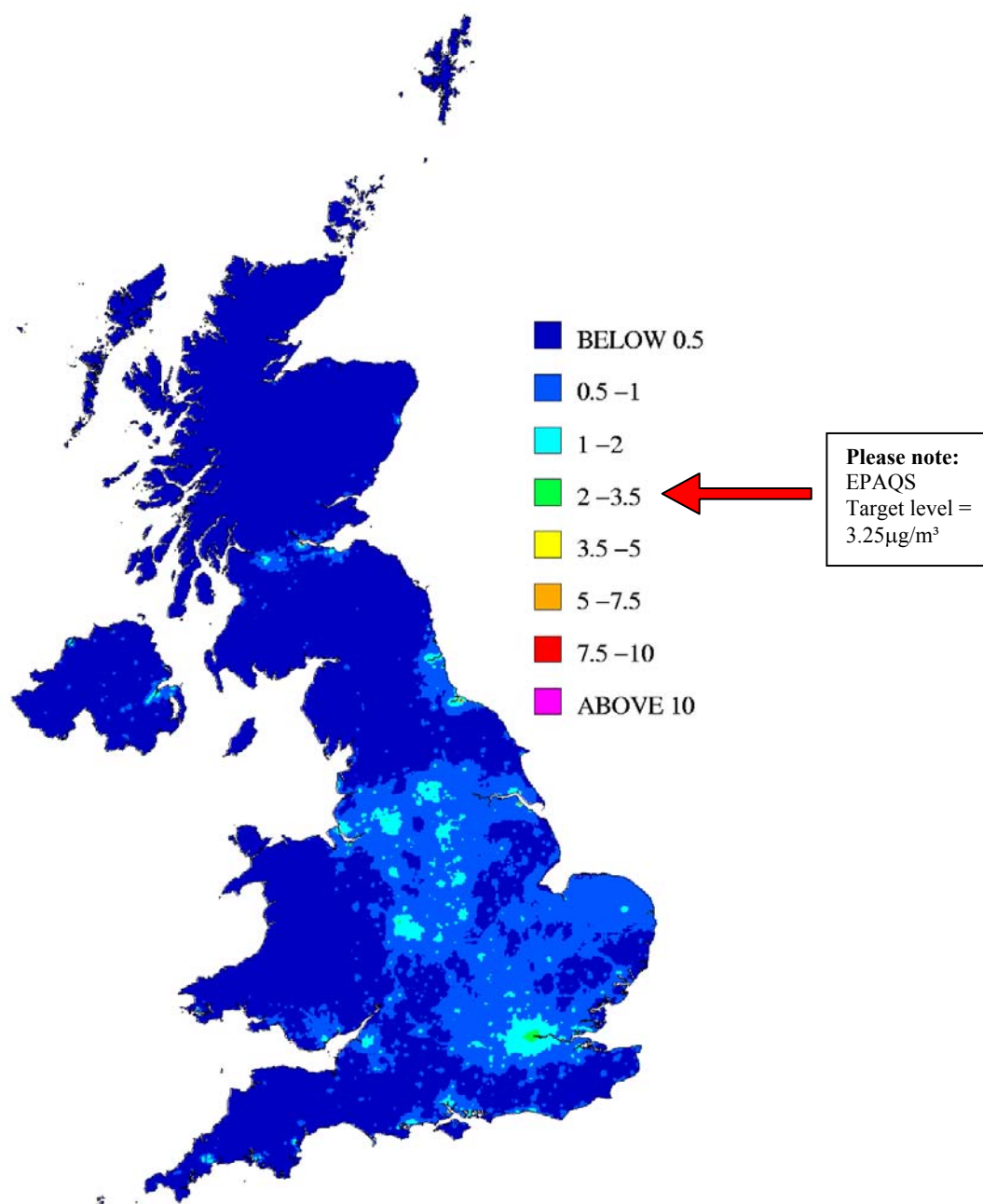
The UK Government and the devolved administrations published an **Air Quality Strategy for England, Scotland, Wales and Northern Ireland** (AQS) in January 2000 (DETR et al, 2000). It sets air quality standards and objectives for eight key pollutants to be achieved between 2003 and 2008. For seven of these pollutants local authorities are charged with the task of working towards the objectives in a cost effective way. The standards and objectives are subject to regular reviews to take account of the latest information on the health effects of air pollution and technical and policy developments.

The AQS objectives for particulate matter (PM$_{10}$), benzene and carbon monoxide were reviewed in 2000/01. An Addendum (Defra et al, 2003) was published in 2003 and incorporated tighter objectives for these pollutants and introduced an objective for polycyclic aromatic hydrocarbons.
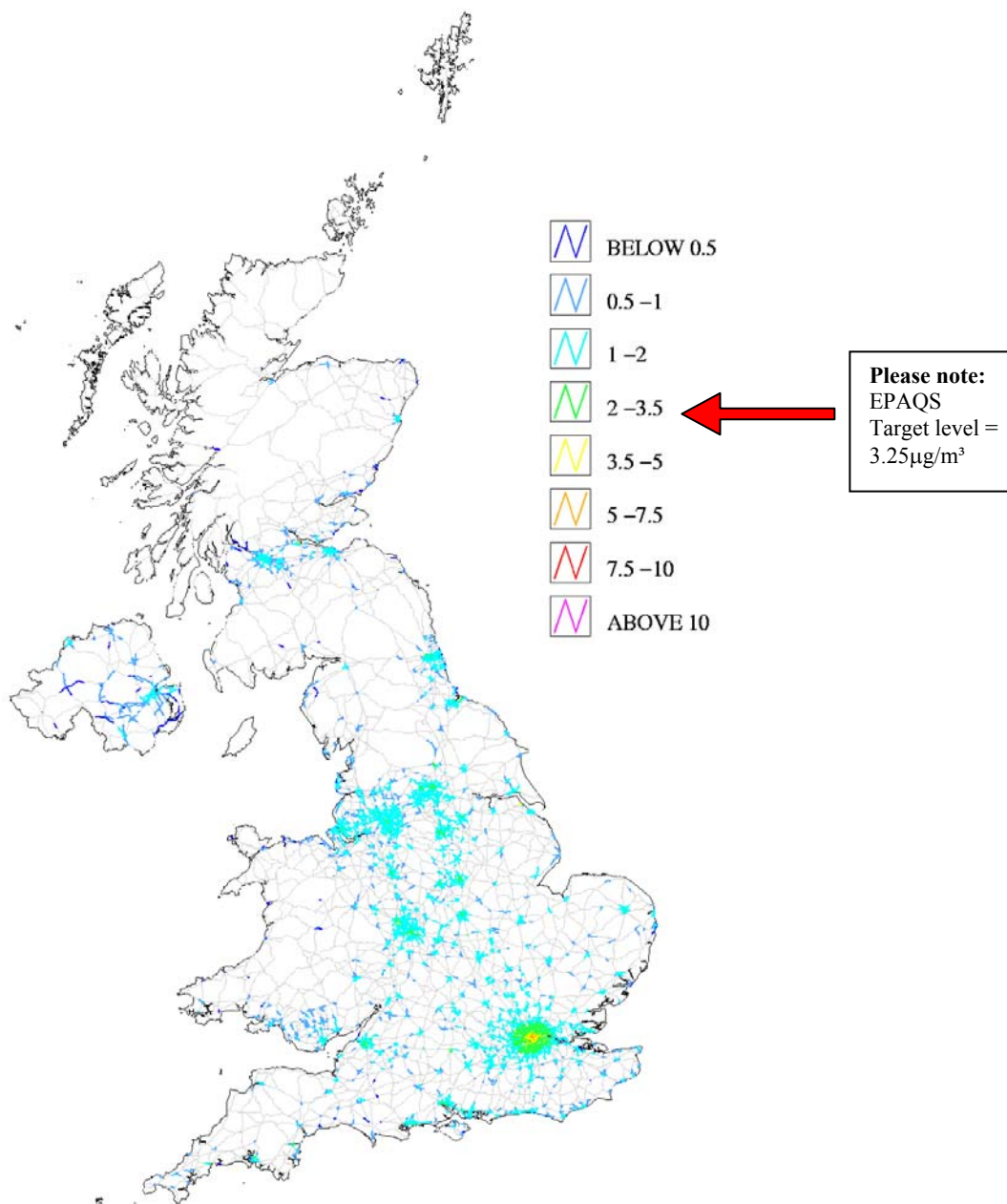
The AQS aims to:
  ➢ Map out as far as possible future ambient air quality policy in the UK in the medium term;
  ➢ Provide best practicable protection to human health by setting health-based objectives for air pollutants;
  ➢ Contribute to the protection of the natural environment through objectives for the protection of vegetation and ecosystems;
  ➢ Describe current and future levels of air pollution; and
  ➢ Provide a framework to help identify what we can all do to improve air quality.

The average concentration in a Middle Layer Super Output Area is the average of the mapped 1km x 1km grid square concentration in the MSOA. An example map of background concentrations of benzene across the UK is shown below:

Colour	Range
BELOW 0.5	
0.5 –1	
1 –2	
2 –3.5	
3.5 –5	
5 –7.5	
7.5 –10	
ABOVE 10	

Please note:
EPAQS
Target level =
$3.25 \mu g/m^3$

The average roadside concentration is the average of the mapped roadside concentrations for the urban major road links (A roads and motorways) in the MSOA. The maximum roadside concentration is the highest mapped roadside concentration for the urban major road links (A roads and motorways) in the MSOA. The figure below provides an example of the distribution of benzene roadside concentrations.

N	BELOW 0.5
N	0.5 – 1
N	1 – 2
N	2 – 3.5
N	3.5 – 5
N	5 – 7.5
N	7.5 – 10
N	ABOVE 10

Please note:
EPAQS
Target level =
3.25μg/m³

Data Classifications

Standard Classifications used (if any):	Not Applicable.
Further Details about Classifications:	Not Applicable.

Edit and Imputation Procedures

Not Applicable.

Validation and Quality Assurance	
Mapped ambient air concentration data are calibrated by comparison with data from ambient air quality measurements from the national air quality monitoring networks. This analysis includes the preparation of scatter plots and the calculation of summary statistics. Mapped concentrations are also verified by making comparisons to other independent ambient air quality measurements of known high quality.	
Geographic Referencing	
Background concentrations data: The boundaries of the Middle Layer Super Output Areas (MSOA) were combined with the grid of 1km squares used in the air pollution modelling. Each MSOA was divided up into 1x1 km squares or parts of squares. Area-weighted concentrations were then calculated for each MSOA by combining the concentrations in each part, or whole square within that MSOA in proportion to their area. **Roadside concentrations data:** A map of the road network was combined with the boundaries of the Middle Layer Super Output Areas (MSOA). A length-weighted concentration for each MSOA was calculated from modelled concentrations for each built-up road link within each MSOA. Roadside concentrations are only modelled on urban (built-up) roads. Roadside concentration data are therefore not applicable in some MSOAs.	
Data Quality	
Relevance:	The scores presented in this dataset are based on annual mean concentrations compared with the EPAQS Standard of 3.25 $\mu g/m^3$. A score of 5 or higher represents an MSOA that has exceeded this standard. Annual mean benzene concentrations can also be compared with the Air Quality Strategy Objective and EU Limit Value of 5 micrograms per cubic metre ($\mu g/m^3$), which has a target date of 2010. Note that the Air Quality Strategy Objective for 2010 in Scotland and Northern Ireland is 3.25 micrograms per cubic metre expressed as the maximum running annual mean, which is roughly equivalent to the annual mean. Annual mean benzene concentrations can be compared with the 2003 Air Quality Strategy Objective of 16.25 micrograms per cubic metre expressed as the maximum running annual mean, which is roughly equivalent to the annual mean.
Accuracy:	The scores in this dataset are derived from <u>modelled estimates</u> of air quality. The data quality objective for the mapped annual mean benzene concentration is that the maximum deviation between the estimates and measured concentrations should not exceed 50%. The modelled concentration at a particular location is subject to greater uncertainty than a concentration measured at an individual automatic monitoring station but the use of models enables data to be provided for the whole country. The symbol "." (single dot) has been used to indicate that data are not applicable. This symbol appears only in the "Score of Roadside Concentration" variable as roadside modelling is only applicable to urban major roads. Therefore a score is not appropriate for some MSOAs.
Timeliness and Punctuality:	Maps of ambient air concentrations are prepared during the year following the year during which measurements have been made. Maps are generally available by the end of September each year for the previous year.

Accessibility and Clarity:	Not Applicable.
Comparability:	These scores <u>cannot</u> be directly compared with similar scores calculated for the other pollutants: SO_2, PM_{10}, NO_2 and ozone, which are also published on the Neighbourhood Statistics website. A score of 1 for benzene is not the same in terms of human health or other environmental impacts as a score of 1 for PM10 for example. This is because the different pollutants have different impacts on health and the environment. Consistent methods are used to map ambient air concentrations across the whole of the UK each year. Air quality modelling methods are updated each year to take account of the latest available scientific information. Maps for each year are therefore not directly comparable with maps prepared for previous years, although the overall approach remains consistent and maps of different years can be used to give an indication of general trends. Details of the modelling are published each year to accompany the maps. Annual mean concentrations cannot be directly compared with air quality targets based on other averaging periods such as 1-hour or 24-hour means.
Coherence:	These scores are not the same as the scores used in Air Pollution Forecasting, such as that reported on the BBC or Met Office Weather forecasts or in the newspapers. Air Pollution Forecasting is based on short term measurements and modelling of air quality rather than on the annual average number.

Disclosure Control

The information presented complies with the National Statistics Code of Practice and associated protocols.

The Office for National Statistics carries out a number of checks to safeguard confidentiality. In accordance with standard procedures, this dataset has been reviewed and approved for release.

Sources for Further Information or Advice

Information about air quality monitoring and national mapping carried out on behalf of Defra and the Devolved Administrations can be found at www.airquality.co.uk. In particular, background information on air quality in the UK is presented in a brochure on the website.

Information on air quality from Defra can be found on the Defra website.

Information on the Air Quality Strategy can be found on the Defra Website.

Specific technical details of the methods used to derive and verify the national maps are available in reports each year. At the time of publication of this dataset the 2005 report is not available. However please refer to the Air Quality website to review the most recent report available on the Air Quality Reports Database. The report title is 'UK air quality modelling for annual reporting 2003 on ambient air quality assessment under Council Directives 96/62/EC, 1999/30/EC and 2000/69/EC' or equivalent for 2005 once this is published.

Information about EU air quality Framework and Daughter Directives can be found: please see the Europa website.

Information about EPAQS standards can be found on the Defra website.

Information on Air Pollution Standards and other methods of banding in Air Pollution Forecasting can be found on the Air Quality website.