Air4EU city assessment for London

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City:	**London**	
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1. Known air quality problems

Under the national Air Quality Strategy, Councils are required to review and assess air quality at regular intervals. Department of the Environment, Food, and Rural Affairs (DEFRA) guidance to local authorities recommends a three stage approach to the review and assessment of air quality. Any parts of the local authority's area where the objectives are unlikely to be met must be designated as air quality management areas (AQMAs). An action plan has to be prepared for each AQMA, within one year of declaration, stating the steps the Council is taking to work towards meeting the objectives. In addition, councils must also prepare 'Local Air Quality Management Progress Report' to show what progress is being made with their Action Plan. The report should include and assess monitoring data collected since previous report and list new planning developments that might affect air quality in the area.

Comp.	**Comments**	**Problem**
NO2	Annual mean objective exceeded at most of stations Hourly objective exceeded at busy roadside locations	YES
PM10	Only small areas currently exceed the annual and 24 hour mean objectives Objectives for 2010 are likely to be exceeded	YES
Lead	No exceedances recorded	NO
CO	No exceedances recorded	NO
Benzene	No exceedances recorded	NO
Ozone	exceeds the rolling 8-hour mean objective at background locations	YES
SO2		NO
1,3- butadiene		NO
PAH		NO

Road traffic is the primary cause of air pollution in London (Fig. 1). The most relevant problem is PM10, NO2 and also O3. The PM10 problem occurs mostly near busy roads.

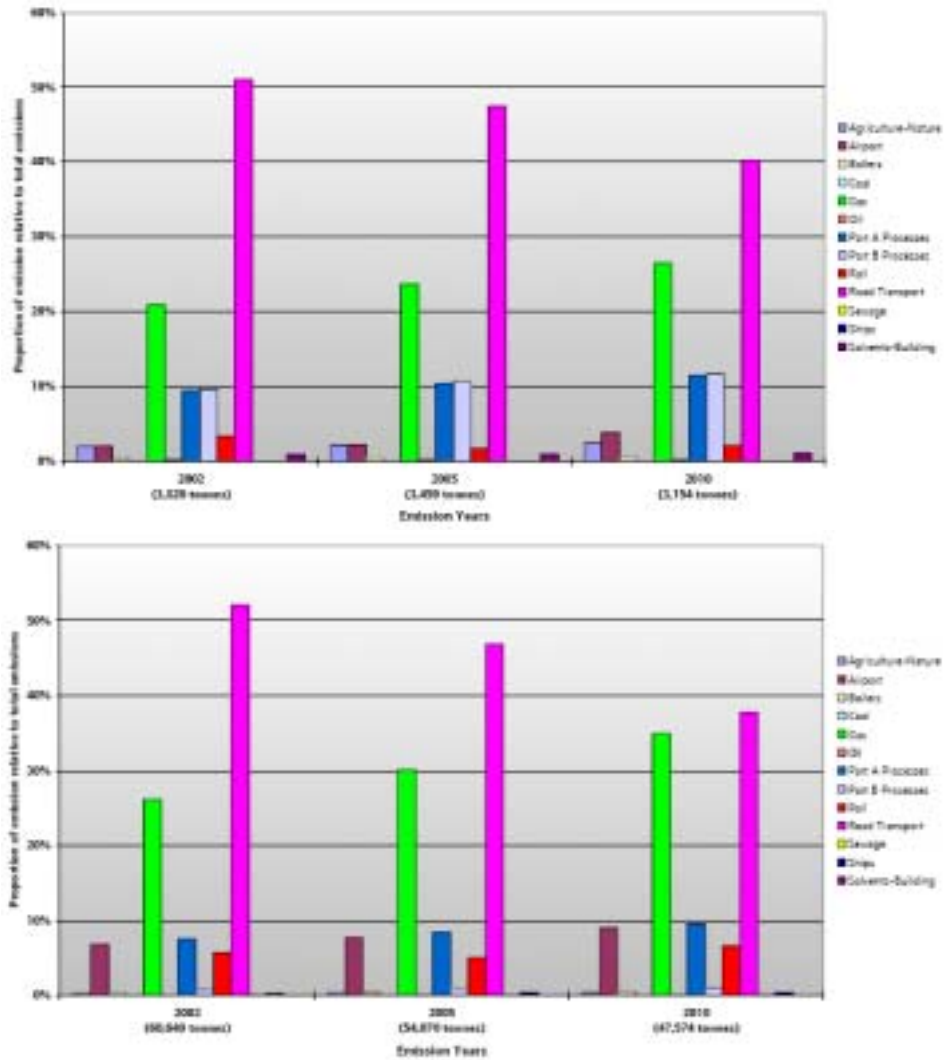

Figure 1 a) Proportion of PM_{10} emissions within the Greater London area; b) Proportion of NO_X emissions within Greater London area. (LAEI 2002, GLA 2005)

2. Monitoring network

There are 94 air quality monitoring stations in the London Air Quality Network (LAQN). The stations are classified as Kerbside, roadside, urban background and suburban.

- "Kerbside" stations are sites sampling within 1m of the kerb of a busy road;
- "roadside" stations are site sampling between 1m of the kerbside of a busy road and the back of the pavement. Typically this will be within 5m of the road, but could be up to 15m;
- "urban background" stations are located at urban locations distanced from sources and therefore broadly representative of city-wide background conditions e.g. urban residential areas.
- "suburban" stations are situated in a residential area on the outskirts of a town or city.

Figure 2 shows the various station types within the LAQN in the year 2000 and 2004.

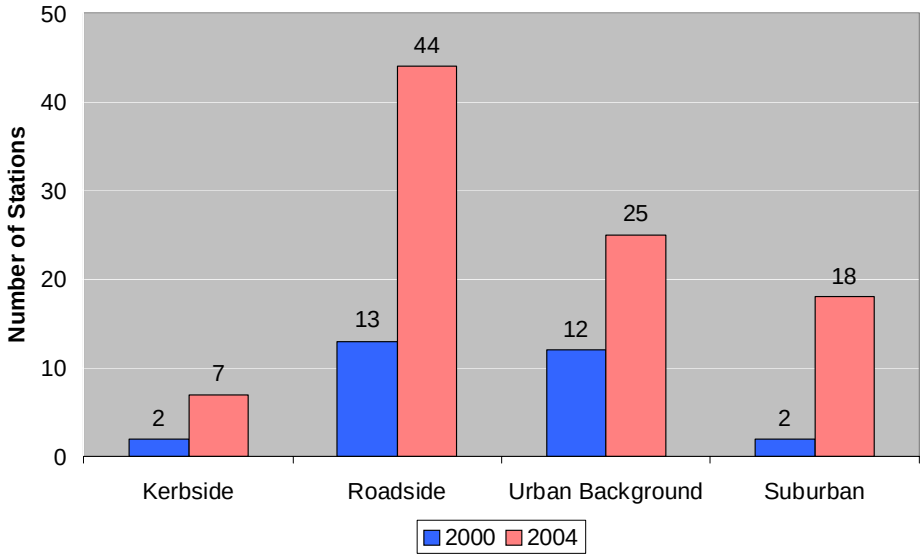

Figure 2 Various air quality monitoring stations in LAQN in year 2000 and 2004

The map in Figure 3 shows the locations of all continuous monitoring sites in the Greater London area.

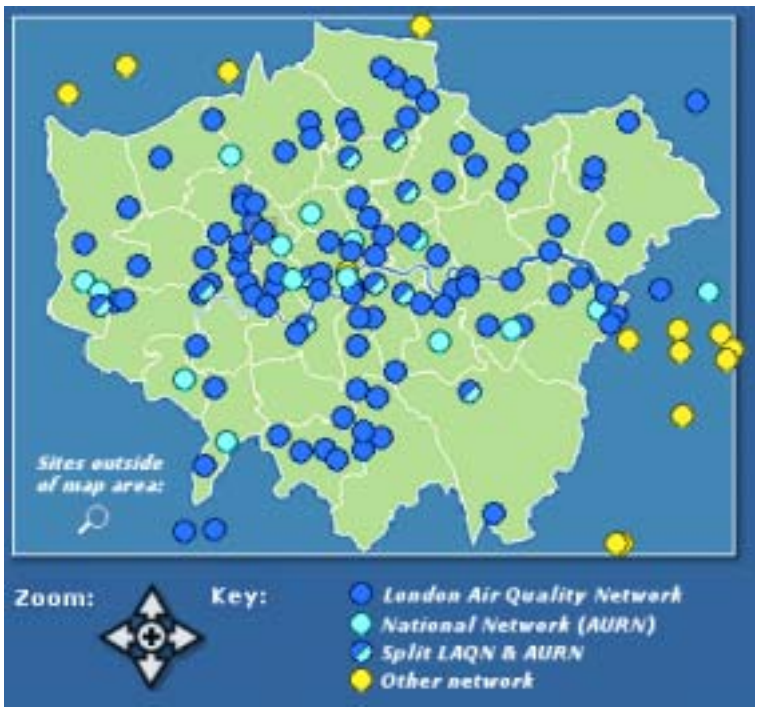

Figure 3 Network details for all continuous monitoring sites (from http://www.londonair.org.uk/london/asp/PublicDetails.asp?region=0)

3. Assessment of regional background

Regional background is determined from monitoring sites representative of rural locations.

4. Emissions inventory

As part of the UK Government's continuing programme on air pollution studies, the Department for Environment, Food and Rural Affairs (DEFRA) has developed the

National Atmospheric Emissions Inventory (NAEI), which compiles estimates of emissions to the atmosphere from UK sources such as cars, trucks, power stations and industrial plant. Currently the NAEI is maintained for DEFRA by the National Environmental Technology Centre (NETCEN). For the Great London area, there is a London Atmospheric Emissions Inventory (LAEI) initially developed in 1997 by the former London Research Centre (LRC) with funding from the European Commission's LIFE programme and the London local authorities. The NAEI and the LAEI are complementary and updated annually. The NAEI uses a "top down" methodology in which national data is allocated to smaller areas on the basis of the resident population and other appropriate indicators of activities. The latest and most comprehensive version of the LAEI is LAEI 2002 and it covers the area within the M25 motorway ring. The LAEI 2002 uses a "bottom up" methodology in which local data is used to compile an inventory of local emissions. The LAEI 2002 is compiled and maintained by GLA as part of the implementation of the London Mayor's Air Quality Strategy (MAQS). Both the NAEI and the LAEI have a 1 km^2 resolution.

Figure 4 shows an example of the distribution of PM10 emissions from the NAEI for the year 2003.

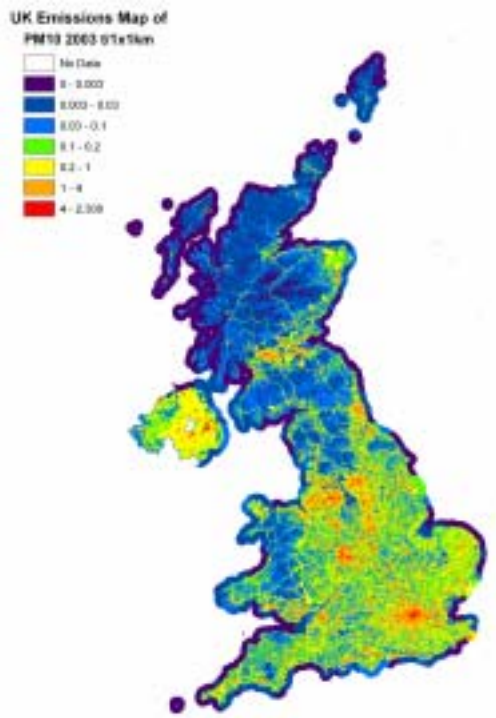

Figure 4 UK emission map for PM10 (year 2003) (from http://www.naei.org.uk/mapping/mapping_2003.php)

5. Models

DMRB

The DMRB Screening Model has been used to assess pollutant levels at relevant receptors that are within 200 m of the centre of a road for the relevant year of the objective in the UK. The DMRB Screening Model can be used to predict the annual

average concentrations of nitrogen oxides, nitrogen dioxide, PM10, carbon monoxide, benzene and 1,3-butadiene. The model is based on empirical statistics derived from the analysis of monitored pollutant data in the UK. As monitoring data indicates a poor relationship between the annual mean and the 8-hour carbon monoxide and 1-hour nitrogen dioxide objective therefore these short-term objectives are not predicted in the DMRB.

ADMS

The Air Dispersion Modelling System ADMS-urban has been used to assess the air quality in the Greater London areas. The ADMS is a Gaussian type of model and have been developed to treat point, line and area sources. It has integrated specific modules to consider the effect of buildings and hills on dispersion of pollutants. The ADMS have incorporated the non-Gaussian or skew profiles fro used under convective conditions. There are two options to simulate NO_X chemistry in ADMS. As a first and simple option it use the empirical curves developed by Derwent and Middleton (1996). As the second option ADMS uses an 8-reaction set rather than the pessimistic ozone-limiting method. The model can treat several important pollutants including Nitrogen Dioxide (NO2); Oxides of Nitrogen (NOx); PM10; and Ozone (O3). The model is linked to external GIS and visualization tools and represents a comprehensive tool for tackling air pollution problems in cities and at local scales.
ADMS-Roads is based on the ADMS-Urban model and is suitable for local-scale studies of the impact of road traffic on air. It includes chemistry algorithms for calculating NO_2 concentrations and allows the user to model explicitly defined roads, several point sources and other emissions as volume sources. ADMS-Roads has been used to calculate NO_x, NO_2 and PM_{10} concentrations on the M4 motorway in South-East England between junctions 11 and 12. Meteorological observations from Heathrow were used in the model with background concentrations of NO_x and ozone from Harwell and PM_{10} from Rochester.

Other models used include the NAME and FRAME model.

Meteorology

For screen models, assessment is carried out using the built-in sample meteorological datasets, for example, in ADMS-Screen. For more advanced model, e.g. ADMS-urban, data from meteorological mast is used.

6. Assimilation methods

No assimilation is carried out in London at the moment.

7. Gaps, needs and focus areas

The following is a list of gaps and focus areas for London.

- What local measures will reduce the street level PM10 and NO2 concentrations?
- What is the future trend of emissions and air quality
- Air quality projection for year 2010: NO2 and PM10
- How should non-exhaust sources be treated in models?
- What is the contribution of UBG/RBG to local air quality?

- What impact can stack plumes have on urban air quality (NO2, PM10)?
- How to quantify the contribution of stacks on regional ozone?

8. Suggested case studies

- Use of simple data assimilation methods to improve the assessment.
- Improve meteorological data
- impact of non-exhaust sources
- Impact of large point sources

9. Actions for implementation of case studies

- Assess the contribution of stationery sources to concentrations of SO2, NO2/NOx, PM10, O3 and sulphur, nitrogen deposition, including plume interactions with the urban environment (London) through chemical and meteorological processes. Investigate the validity of simple formula, for example NO to NO2 oxidation, in simpler dispersion models. The importance of meteorological data will be incestigated.

- Investigate the impact of traffic management measures on local air quality. The change in local pollution levels due to the emission changes as a result of changes of fleet composition, fuel type, driving pattern (e.g. speed, road) etc will be investigated. The effect of non-exhaust emissions will also be evaluated. Assess the contribution of urban and regional background to local air quality. A simple data assimilation approach will be used to demonstrate how model predictions can be improved with the use of measurement data.