

Source Apportionment Project, SAP

A contribution to subproject SATURN

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Summary

Research has continued on the application of modelling to investigate abatement strategies in the context of attaining targets set for London in the UK Air Quality Strategy and EU Directives. The two most difficult pollutants are PM₁₀ and NO₂, for both of which it is necessary to superimpose the contributions from local roads or hot-spot areas on urban background levels across the city. Thus the Urban Scale Integrated Assessment Model, USIAM, has been applied to investigate a wide range of abatement scenarios for PM₁₀ from transport, based on source apportionment to distinguish contributions from different types of vehicle in different districts or specific roads. There are two areas of London where attainment of standards appears particularly difficult, one in central London, and the other in the vicinity of Heathrow airport to the west of London. A separate study has therefore started, based on similar principles to the USIAM model, but addressing in detail the limited area surrounding the airport.

More fundamental research on modelling dispersion has continued using the MIMO and MEMO models. MIMO has been used to extend previous 2 dimensional studies of a parallel canyons of varying geometry to three dimensional flow patterns. MEMO has also been used successfully to simulate NO_x concentrations across London for a specific period, and the results compared with measurements. This is the first time an Eulerian model has been applied and tested in such a way for London.

Aim of the research

In developing strategies to reduce exceedance of air quality standards it is important to have a reliable understanding of the relative contributions of different sources to the atmospheric concentrations. The aim of this project is therefore concerned with modelling of source apportionment, differentiating contributions at any point from emissions from a wide range of sources (both mobile/traffic related and stationary) over different distance scales from within the local street, to neighbouring streets and the local area, out to city and regional scale.

Activities during the year

Local scale modelling with MIMO and the larger scale MEMO model

Work by Kiki Assimakopoulos has concentrated on completing incorporation of a fast chemical module for NO_x-O₃ reactions within 2-dimensional street canyons. She has also undertaken some initial studies of 3-dimensional dispersion in and between intersecting street canyons with MIMO to investigate situations in which the 2-dimensional treatment still approximately seems valid. There is clearly much further work that could be done here.

However because studies of London have hitherto not included Eulerian modelling, and as a first step to modelling of ozone over London, Kiki Assimakopoulos turned to the MEMO

model, and used it to simulate NO_x concentrations across London for a three day period in the summer of 1999. This indicated some marked effects of London topography on wind fields, despite the modest valley and terrain. The concentrations of NO_x compared well with measurements of NO_x at background monitoring stations on central and inner London, although round the outer areas concentrations were too low because of the need to embed in a larger region contributing to imported contributions.

Integrated assessment of abatement strategies for PM10 in London

The USIAM model has been used to investigate a large number of scenarios for abatement of traffic emissions derived by W S Atkins for the UK Department of Environment and the Regions (now DEFRA). These involved combinations of both technological measures such as the fitting of particulate traps and conversion to CNG/LPG, and traffic control measures such as restricting traffic, improving public transport as an alternative to private vehicles, and imposing charges to enter certain zones or for parking. This work provides an example of how atmospheric modelling and traffic modelling can be combined successfully to compare and assess different ways of achieving air quality targets as part of a cost benefit study. It could easily be extended to NO₂ as well, and has also provided a prototype for urban assessment to integrate with longer range national and transboundary air pollution assessment in the work of the UK National Centre for Integrated Assessment of Abatement Strategies based at Imperial College.

Study of air pollution round Heathrow airport

Modelling studies have tended to indicate very high concentrations of pollutants such as NO₂ round Heathrow airport, as high as those in central London. However modelling of such areas requires careful analysis, including the contribution of aircraft emissions during take-off and landing, traffic serving the airport and other airport related emissions, and the different exposure patterns of residents, passengers, workers etc. A specific study has therefore been initiated linking emission inventories, dispersion modelling, and local characteristics within a GIS system, building on the same concepts of integrated assessment as in the USIAM model but adapted for this more local scale. This study is still in the early development stage.

Aims for the coming year

The main focus will be on the more applied side of this project, and development of tools to assist in development of abatement strategies. Specifically this included development of the airport modelling, and the specific dispersion problems raised in this context. A logical extension of this work would be to couple modelling of air pollution concentrations with mapping of noise levels, though this is not currently included in the work plan and schedule.

More detailed work on dispersion within and around streets depends on research proposed as a result of a sister project in SATURN led by Dr Colvile, and combining CFD modelling and wind tunnel modelling with field experiments in an urban environment.

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