

Wide area analysis using the ADMS model for environmental monitoring and assessment

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Presented

by

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Contents

- ADMS-Urban
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- Examples of model application
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CERC founded in 1986 – Links to University

- practical application of state of the art environmental science
- initially focussed on research
- subsequently software development
- by year 2000 over 20 highly qualified staff

Strategic Environmental Impact in urban and industrial areas – focus air quality



ADMS-Urban I

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- ADMS-Urban is designed to model the impact of the full range of emission types across an urban area at very high resolution;
- Advanced-Gaussian type model nested in regional trajectory model;
- Includes chemical reaction scheme(s), meteorological preprocessor, effects of changes in roughness and terrain elevation;
- Allowance for up to 6,500 sources: upto 3,500 explicit sources - road (1,500, each with up to 50 vertices), point, line area and volume (1,500), aircraft jet sources (500); grid sources upto 3,000;
- Fully integrated street canyon model based on OSPM;

ADMS-Urban II

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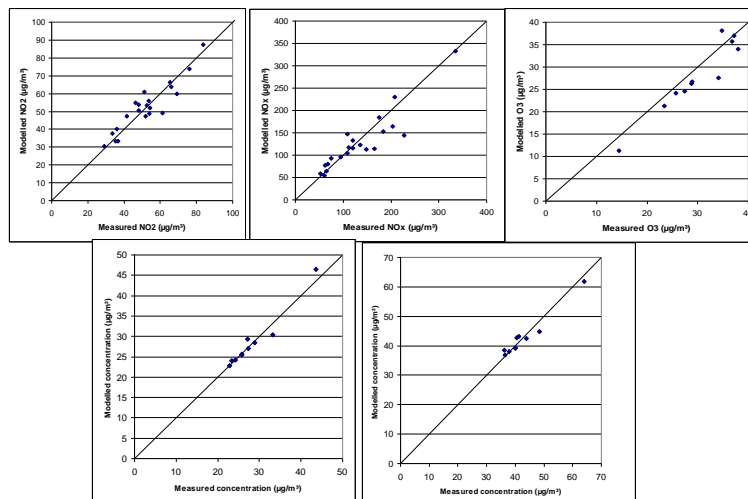
- Calculates emissions from traffic flows or accepts calculated emissions;
- Integration with Geographical Information Systems (GIS) and an Emissions Inventory Database (EMIT);
- Output via GIS includes high resolution pollutant concentration maps;
- Can consider Air Quality Management and Mitigation Options e.g. Low Emission Zones, Technical Options, Traffic management; source apportionment;
- Model first released in 1997 – has been used in many cities worldwide including in London, Paris, Rome, Beijing, Shanghai, Singapore, Barcelona, Vienna ...

Comparison with data

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LONDON

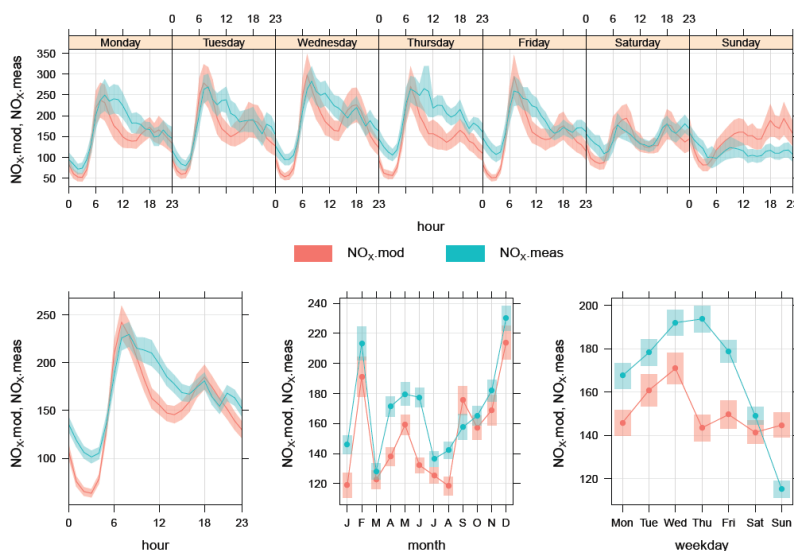
- Model validation at Automatic Sites – Annual Means NO_2 , NO_x , O_3 , PM_{10} (annual mean and 90.4th percentile)



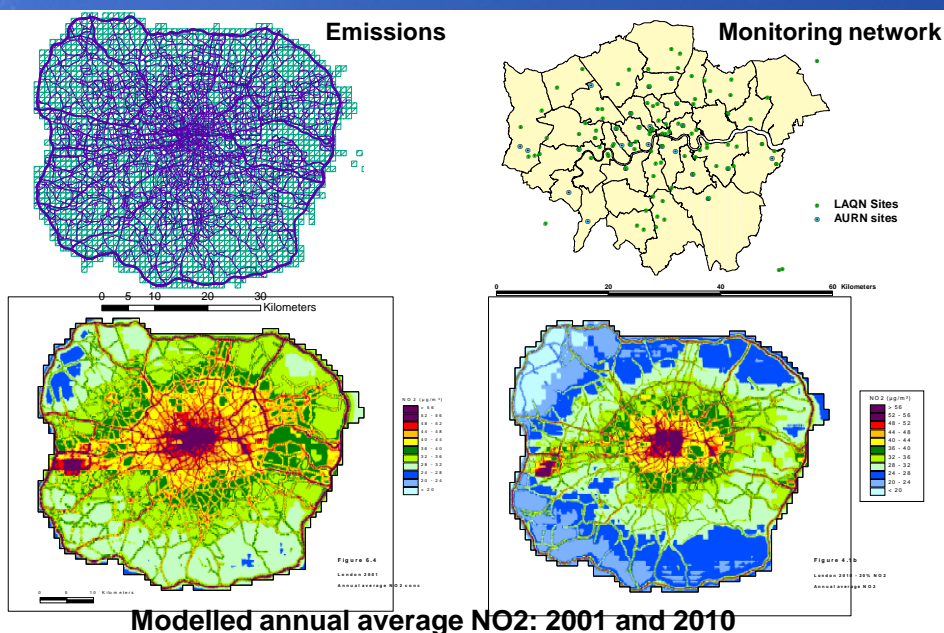
ADMS-Urban – Validation at Shaftsbury Avenue From DEFRA model inter-comparison exercise (D Carslaw)

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Weekday, hourly , monthly profiles



Assessment of Air Quality - London CERC



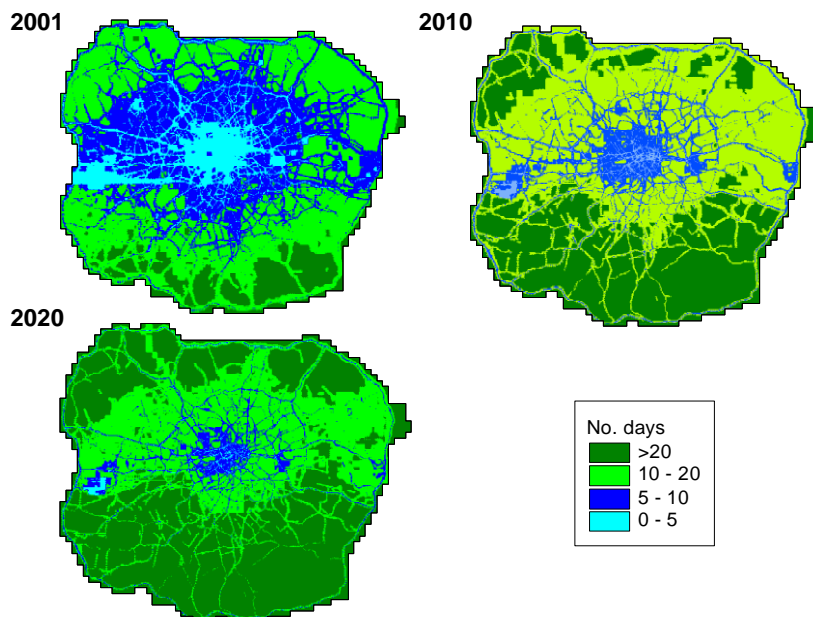
Impacts of different planning /policy scenarios CERC

ADMS-Urban can be used to test impact of action plans or policies (local, urban, regional or national scale) at local up to large urban scale. Examples of applications:

- Business as usual (e.g. implementation of legal requirements – NECD, Vehicle EURO standards etc...)
- UK Dept. Environment (2006) – Consultation on “options for further improvements in air quality” – included policy Measure Q:
 - Programme of incentives for early uptake of Euro V and VI standard vehicles
 - Programme of incentives to increase penetration of low emission vehicles
 - Small combustion plant measures
- Traffic Management measures e.g. London Low Emission Zone/ Congestion Charging Zone
- Multiplicity of measures e.g. Beijing - controls on industry/power supply; domestic coal burning; many traffic reduction policies.

Assessment – Business as usual. Number of days in which the 8 hour maximum concentration of ozone exceeds 100µg/m³

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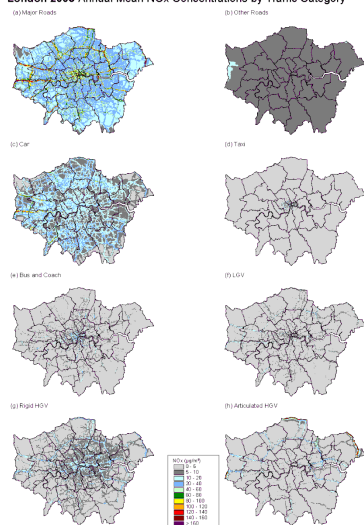


London – Business as Usual

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ASSESSMENT – LONDON, Source apportionment

London 2005 Annual Mean NOx Concentrations by Traffic Category



- London 2010 annual mean NOx concentrations, presented by traffic category, to identify the main sources of pollution

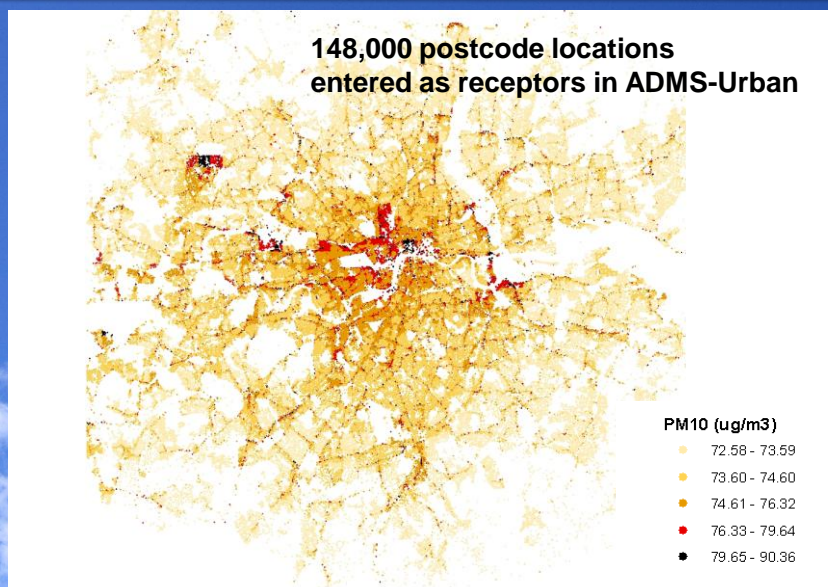
Impact of Measure Q on annual average NO₂ concentrations

	2010		2020	
	Base	Q	Base	Q
Population weighted mean (µg/m³)	35.0	34.6	31.2	29.8
% Area exceeding 40µg/m³	12.8	11.9	6.2	4.5
% Population exceeding 40µg/m³	19.9	18.1	10.6	8.0

Impact of Measure Q on population weighted annual average PM_{2.5} concentrations

	Base	Q	Measure Q Reduction
2010	13.8	13.7	1.1%
2020	12.6	11.8	6.7%
Year Reduction	9.0%	14.1%	

Health risk assessment to air pollution episodes: modelled exposures by postcode in London: 8th August 2003



London Low Emission Zone (LEZ) and Congestion Charging Zone

Area of the Zone

Same as the Congestion Charging Scheme

Up to - but not including - the North South Circular

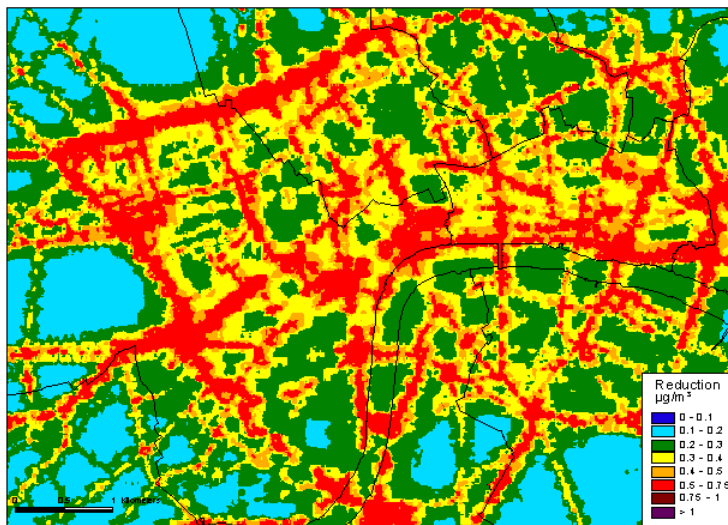
Heathrow

The Greater London boundary

Up to - but not including - the M25

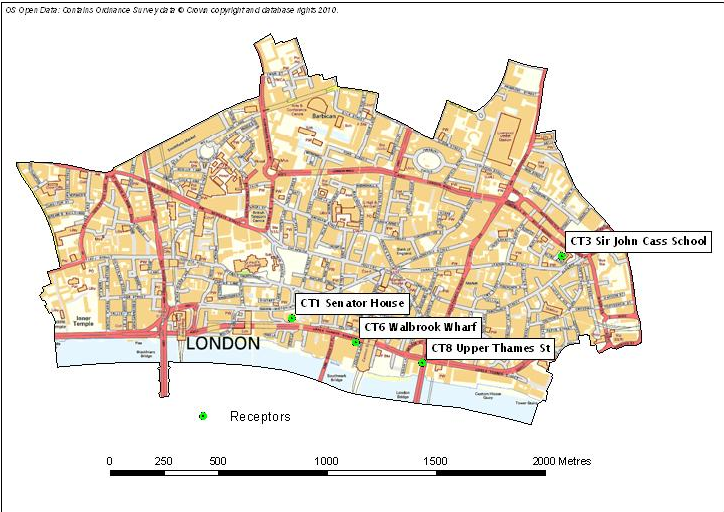
An outer London area (stand-alone)

St Albans, Watford, Hertsmere, Enfield, Epping Forest, Brentwood, Havering, Thurrock, Dartford, Sevenoaks, Tandridge, Reigate and Banstead, Mole Valleys, Guildford, Woking, Elmbridge, Spelthorne, Runnymede, Sandhead, Heathrow, Hillingdon, Bucks, Harrow, Three Rivers, Barnet, Haringey, Waltham Forest, Redbridge, Barking and Dagenham, Newham, Greenwich, Bexley, Bromley, Croydon, Sutton, Kingston, Merton, Wandsworth, Lambeth, Lewisham, Southwark, Westminster, Camden, Islington, Hackney, Tower Hamlets, H & F, K & G, Ealing, Hounslow, Richmond, M25, North-south circular



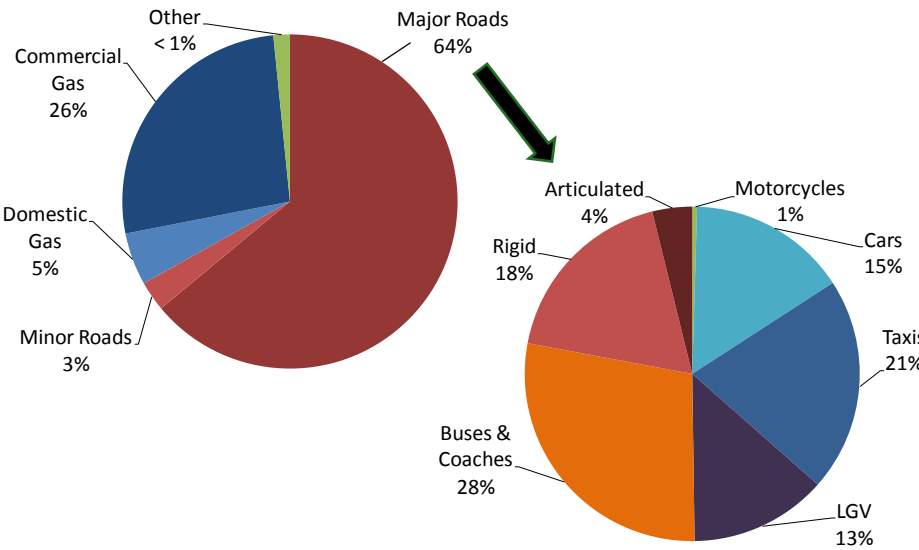
City of London Study
Location of source apportionment receptors

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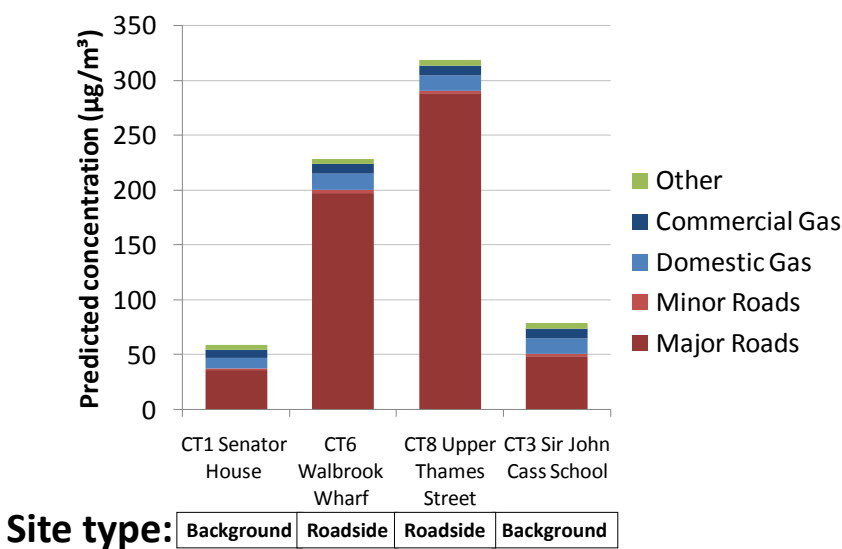
City of London study
NO_x emissions by source type

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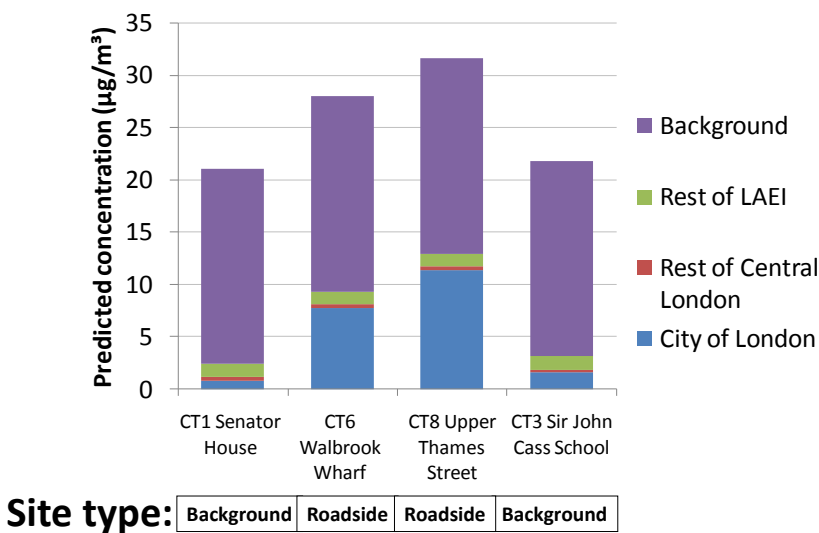
City of London study
NO_x source apportionment by source type

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City of London study
PM₁₀ source apportionment by location

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City of London - 2015 Congestion charging zone (CCZ) and North/South Circular scenarios

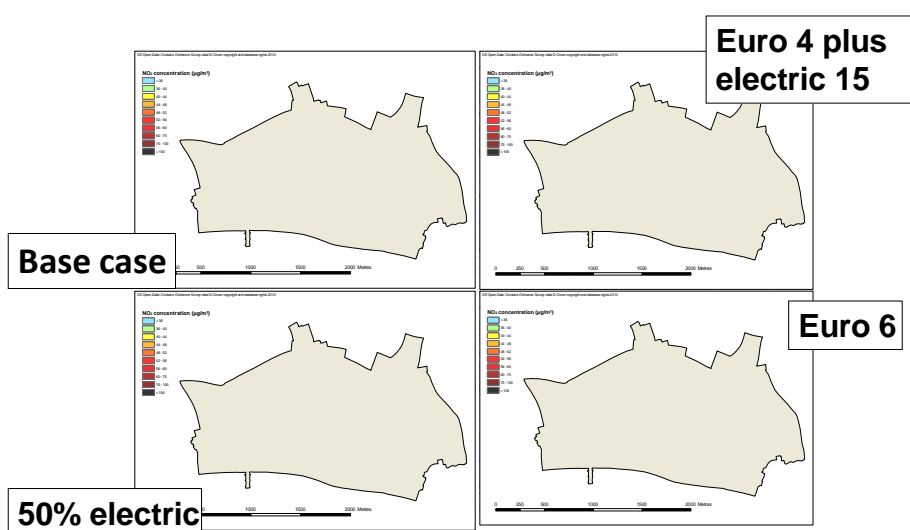
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Name of scheme	Description of scheme	Area affected	Pollutants assessed
Euro 4 CCZ 15	Minimum standard of Euro 4 for all diesel vehicles	CCZ	NO _x
Euro 4 NS 15	Minimum standard of Euro 4 for all diesel vehicles	North/ South Circular	NO _x
Euro 4 plus electric 15	Minimum standard of Euro 4 for all diesel vehicles & electric taxis	CCZ	NO _x
50% electric	50% of taxis vans & cars are electric	CCZ	PM ₁₀ , PM _{2.5} & NO _x
Euro 4 plus electric & biomethane	Minimum standard of Euro 4 for all diesel vehicles, electric taxis & biomethane used by 50% lorries & large vans	CCZ	NO _x
Euro 6	Minimum standard of Euro 6 for all diesel vehicles	CCZ	NO _x

City of London study

Different 2015 scenarios - annual average NO₂

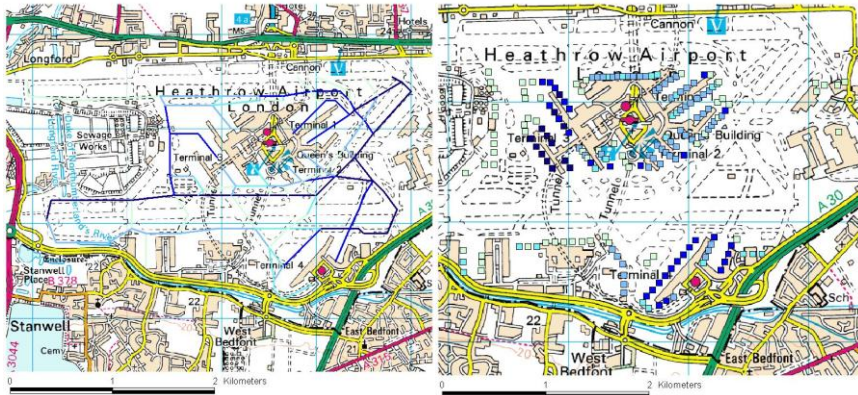
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London Heathrow Airport Emissions

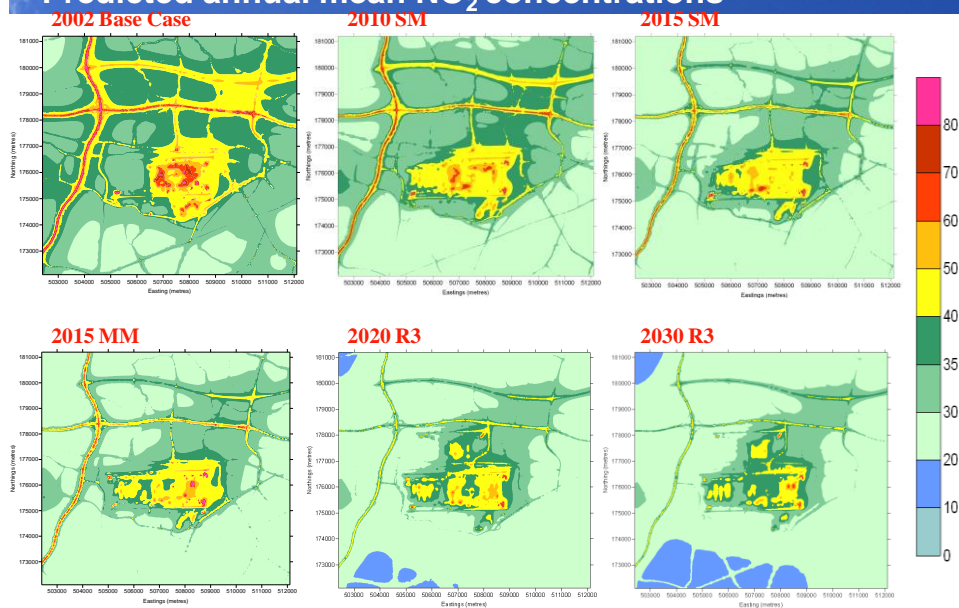
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- Major study of government plans for airport expansion
- Need to consider aircraft sources: take-off, landing, taxi out, APU (Auxilliary Power Units) etc.



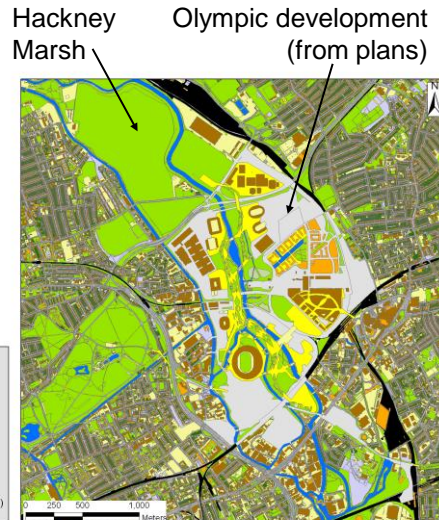
London Heathrow Airport Predicted annual mean NO₂ concentrations

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Impacts of developments on temperature Olympic Parkland development (LUCID project) CERC

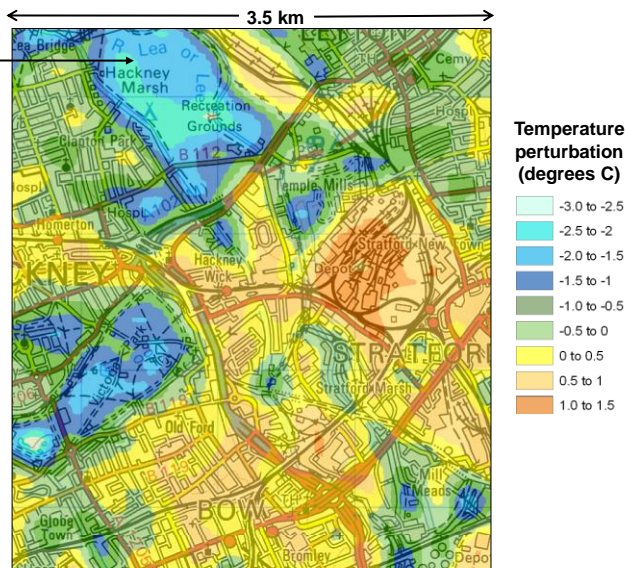
- 3 scenarios:
 - Pre-Olympic,
 - Olympic Parkland 2012
 - Olympic legacy
- *Absolute* temperature perturbations due to land use variations modelled
- *Relative* temperature changes due to developments calculated



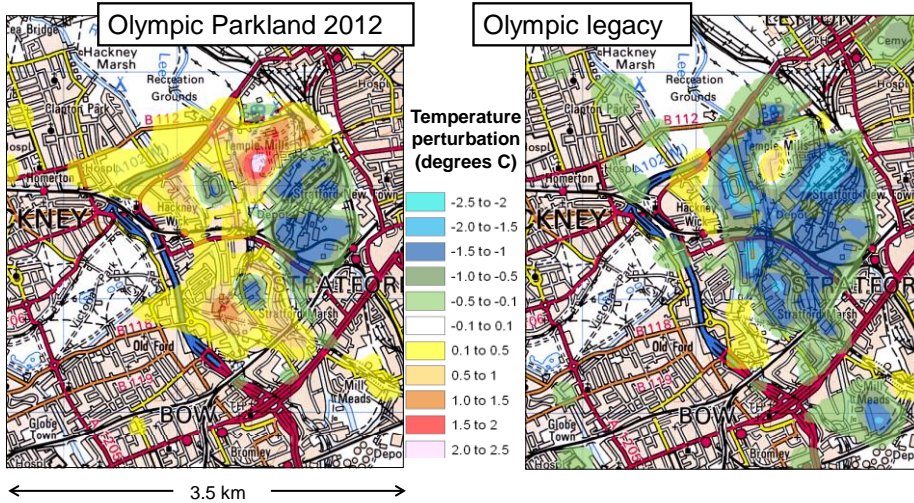
Example case studies: Olympic Parkland development (LUCID project) CERC

Hackney Marsh

Pre-Olympic temperature perturbations to the upwind boundary layer profile at 2m due to land use variations 19:00 on 10/06/2006 overlaid onto a map. © Crown copyright, All rights reserved. 2009 Licence number 0100031673



Example case studies: Olympic Parkland development (LUCID project) CERC



Differences in predicted temperatures (2m) due to land use variations at '19:00 on 10/06/2006'.

Beijing's air quality: emission controls CERC

- Emission reduction over 10 years - energy, traffic, construction, industrial
- Final stage on 20 July 2008
 - reduction in the use of private cars
 - further reduction in the use of government cars
 - a temporary halt to construction during the Olympic period
 - more cleaning of the roads to reduce dust
 - the suspension of heavily polluting industry
 - a reduction in production for coal-based enterprises



Vehicles restricted to operating on alternate days according to whether the final number on their licence plate is odd or even

Green sticker for Euro I (III) or above for petrol (diesel) vehicles



Signs alert drivers to areas of congestion and inform if the roads are free flowing



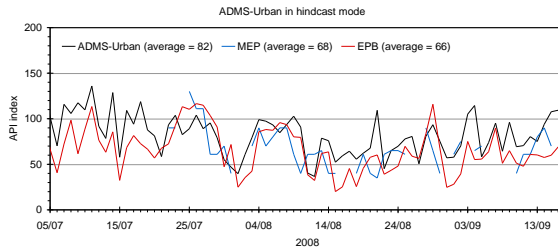
Higher polluting vehicles banned on urban roads from 1 July to 20 September - no yellow stickers



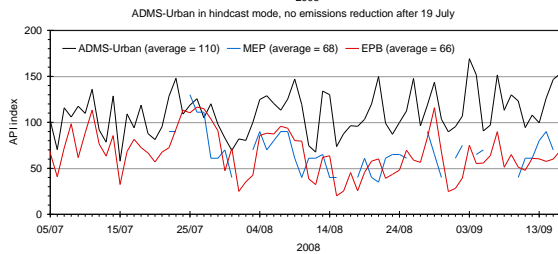
Special dedicated lanes should ease congestion for vehicles associated with the Olympics entitled to use them



Beijing's air quality: emission controls CERC



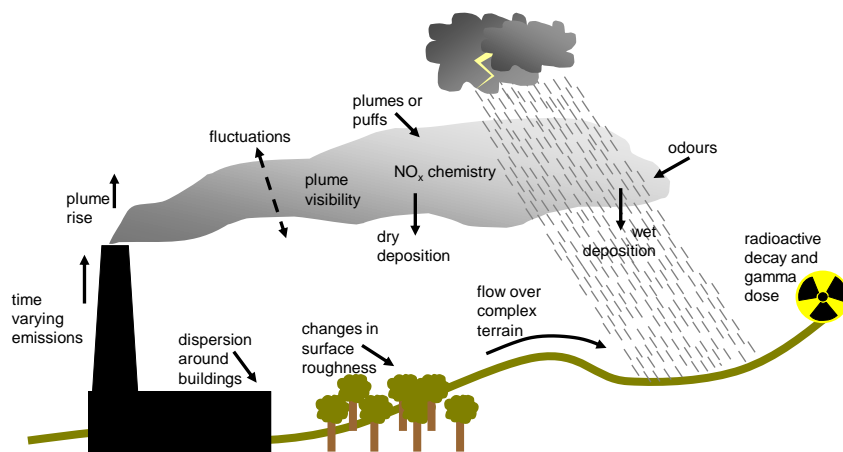
**With emission
reduction measures**

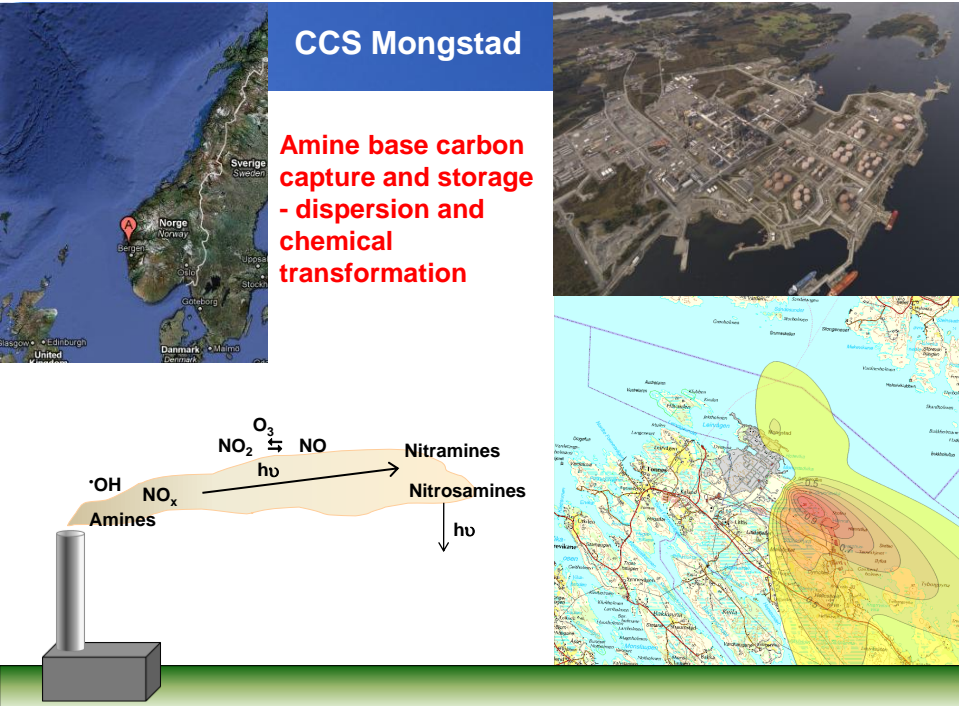


**Without emission
reduction measures**

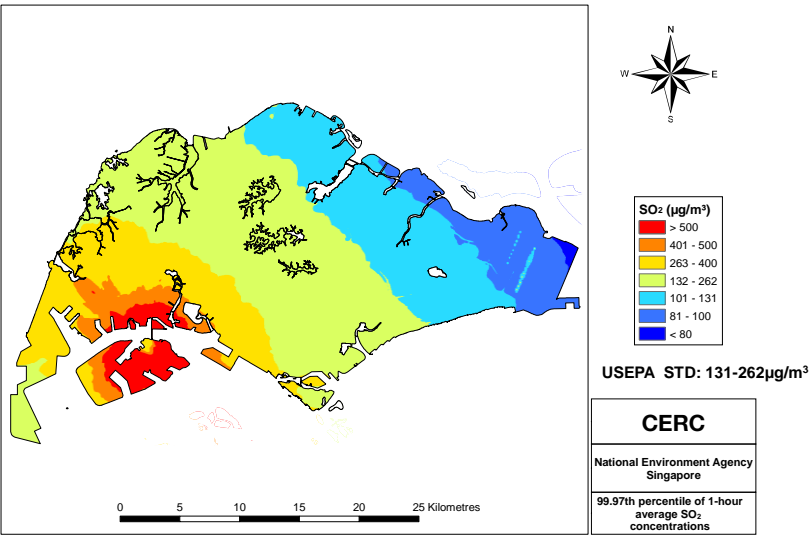
Industrial sources Features of ADMS

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Singapore: 99.97th percentile of 1-hour mean SO₂ **CERC**



Conclusions

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- ADMS-Urban is used routinely across the world for assessing the impact of local, regional and national planning and policy assessment on air quality at the local up to large urban scale.



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