

UK CASE STUDIES

**Air Pollution Impact of Traffic (London) and
Point Sources (S E England)**

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Motivation

- How can we estimate the impact of traffic management strategies on local (street level) air quality?
- How do industrial points sources affect air quality on urban/regional scales?
- What type of methods/tools should be used?

- Case study 1 - Impacts on the local scale
 - Multi-model approach to achieve different levels of detail with consistent use of input data (eg meteorology and emissions)
 - OSCAR Air Quality Assessment System (www.eu-oscar.org)

- Case study 2 - Impacts on urban and regional scales
 - Numerical modelling framework incorporating consistent treatment of meteorology, dispersion and chemistry within a nested domain structure
 - Models 3 (MM5/CMAQ)

Case Study 1 – local scale Emissions/Scenario Options

- 1) Technology changes and impacts on emissions
- 2) Reduce cars in favour of public transports, e.g., bus
- 3) Reduce HDVs
- 4) Effect of Traffic Speed on emission, hence AQ
- 5) Future projections
- 6) Effect of Background Concentrations

Base Case Study

Study area: Marylebone Road (St canyon)
Cromwell Road (Open Road)

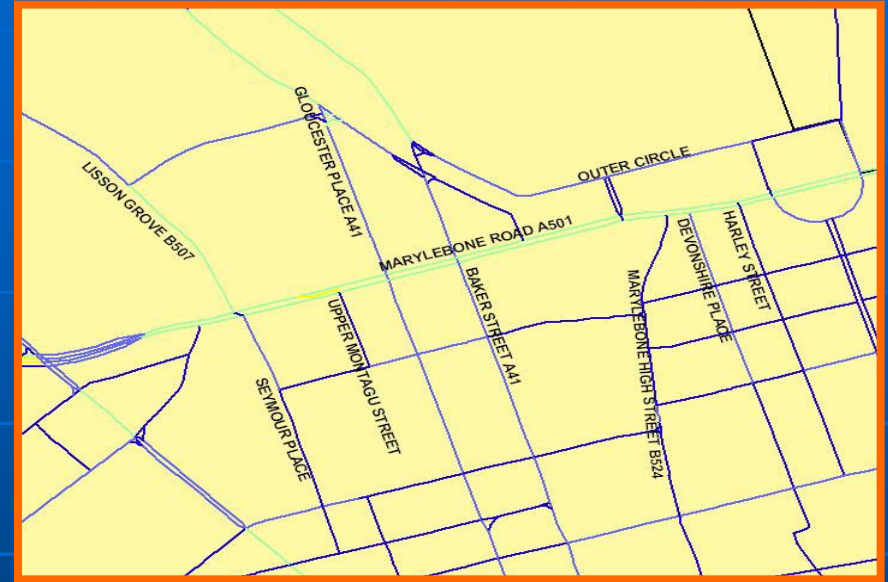
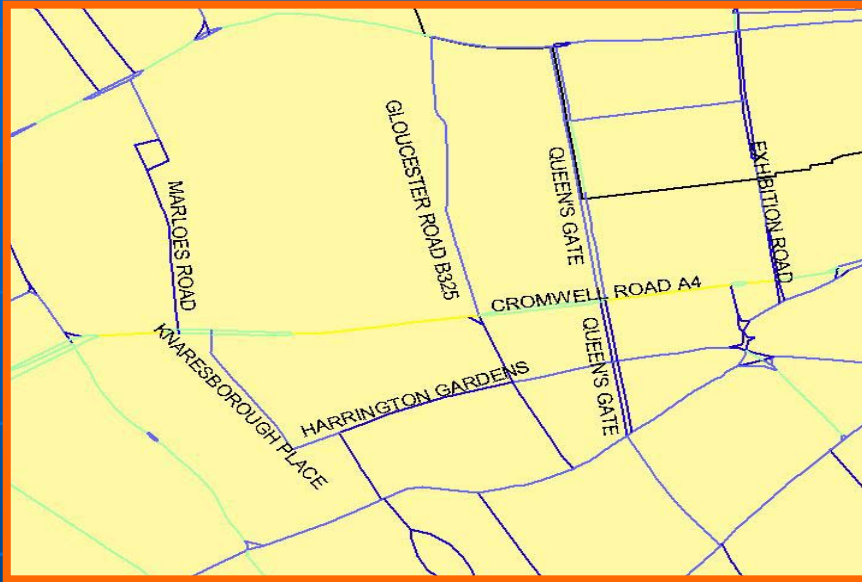
Study Year: 2002/2003

Time scale: Annually (by CAR-II), Hourly (by CAR-FMI)

Input Data: Traffic Information to generate emissions
Meteorological Data from LWC Stations
BG Concentrations

Pollutants: NO, NO₂, NO_x, PM_{2.5} and PM₁₀

London Study Areas



Cromwell Road

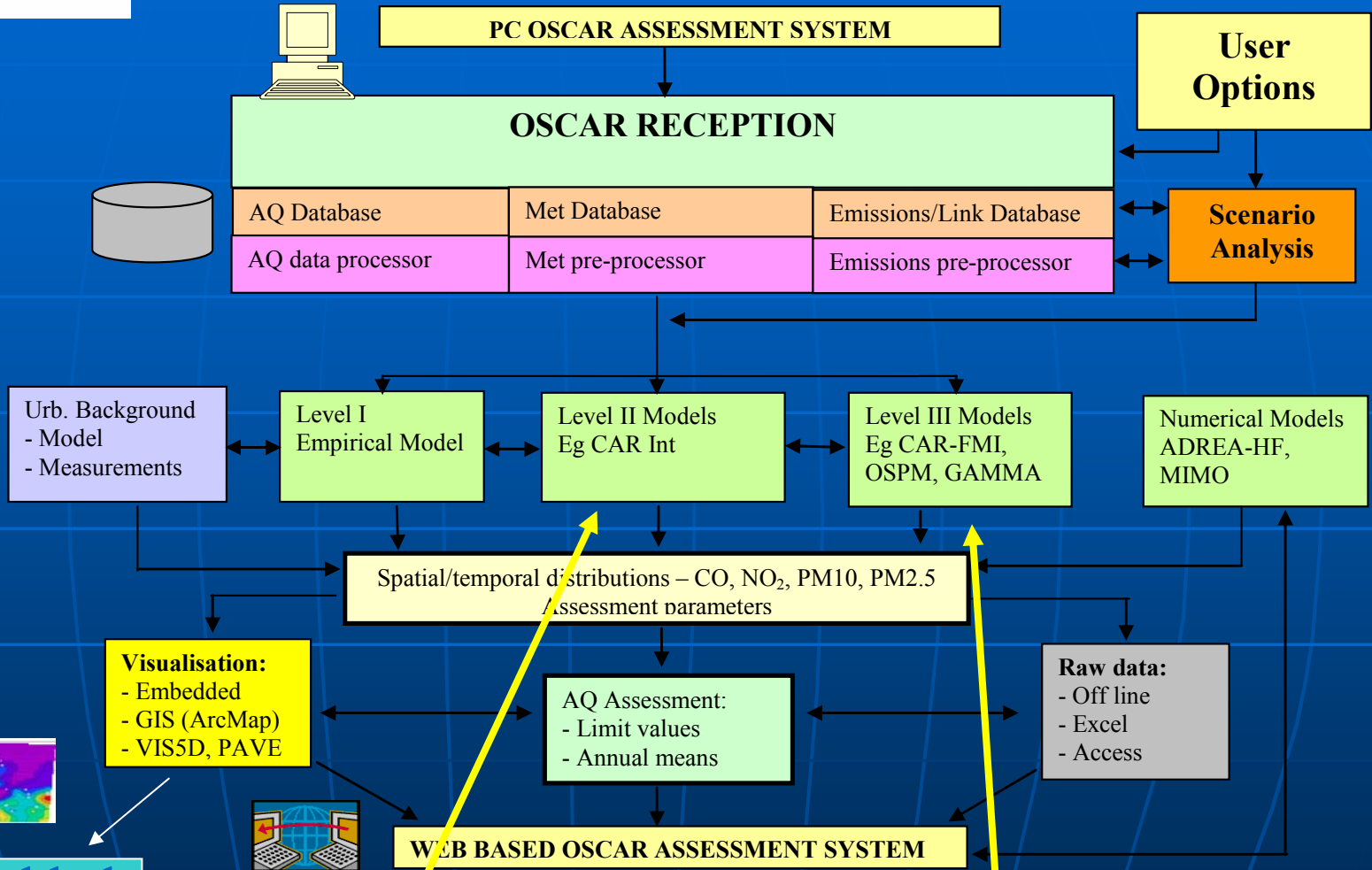
Marylebone Road



Greater London

OSCAR System

Screening
High res.
Open road
St Canyon
Network

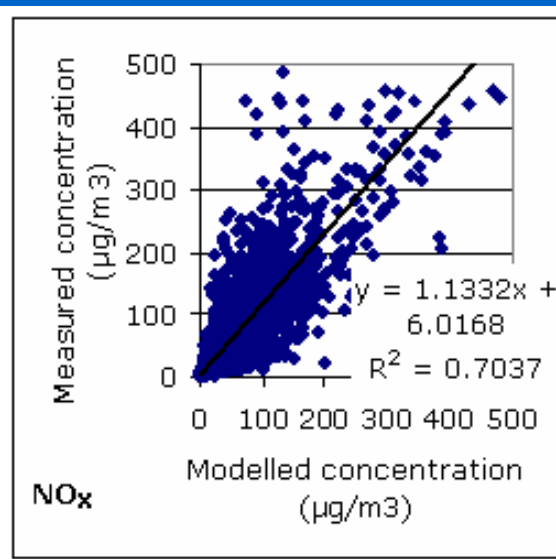
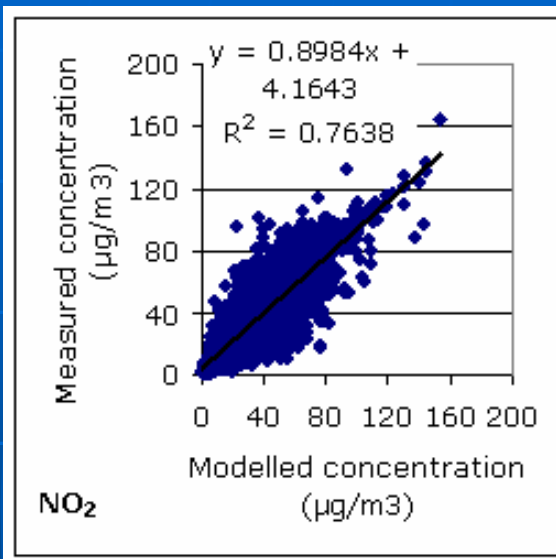


Embedded
PAVE, GIS

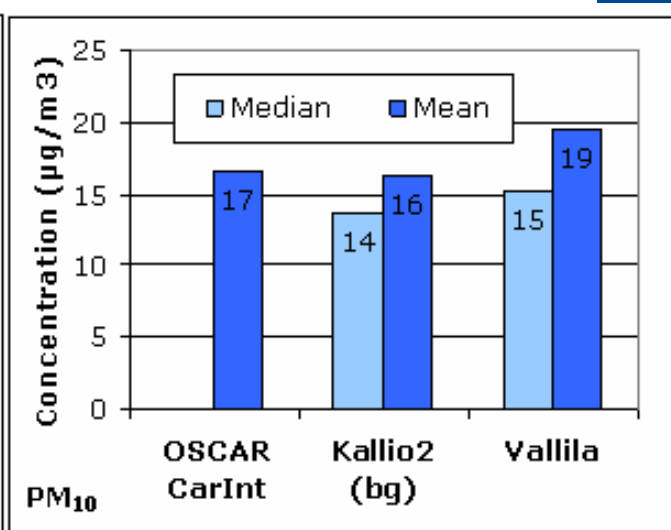
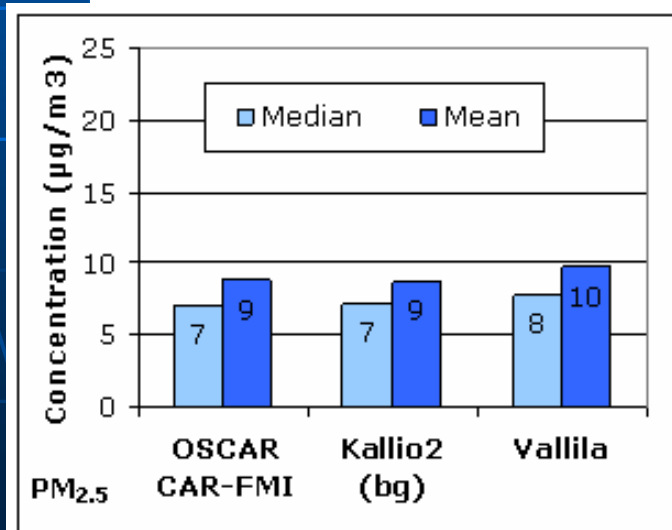
CAR II

CAR-FMI

Evaluation OSCAR CARI1 + CAR-FMI

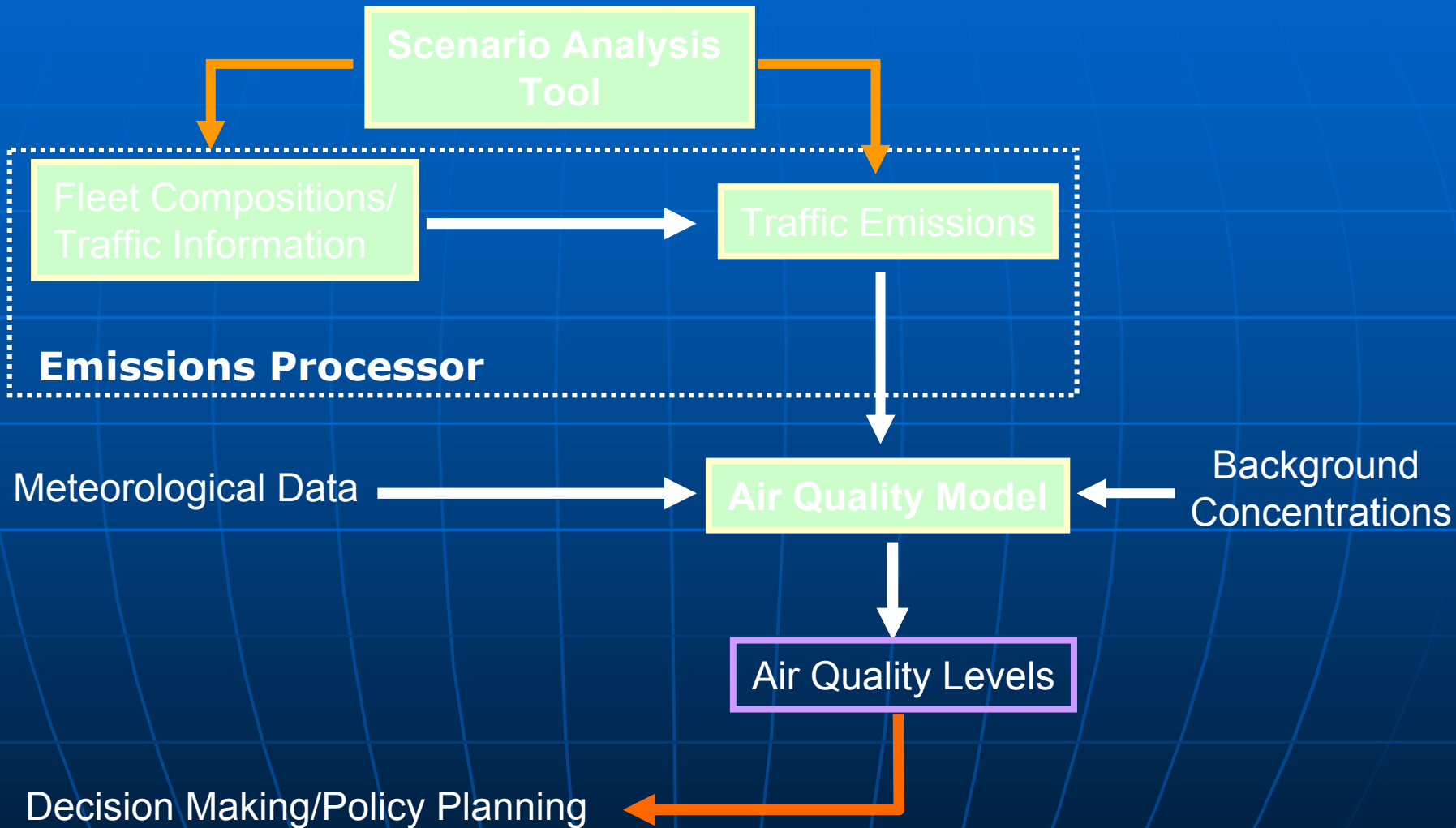


CAR-FMI
Hourly data from Vallila

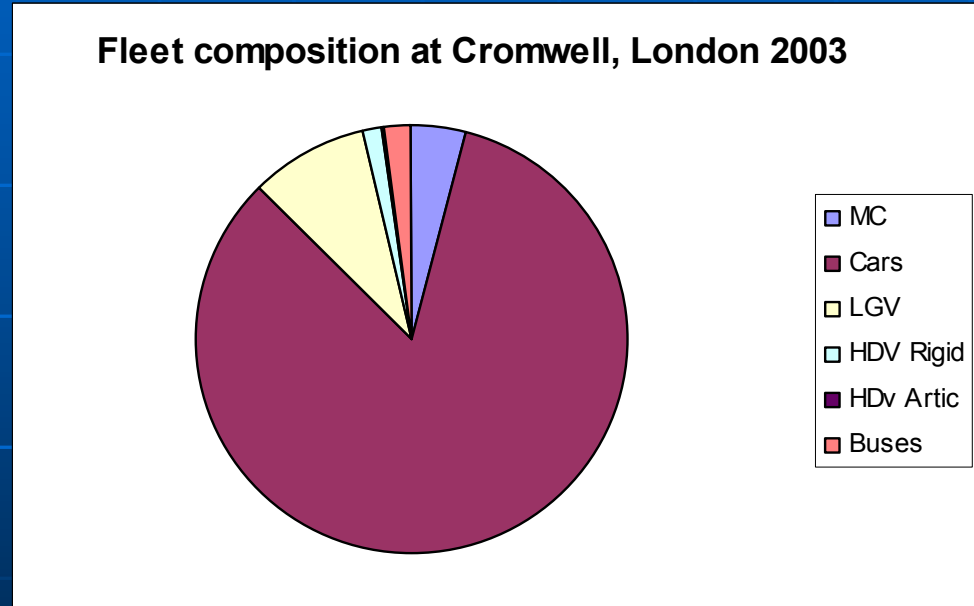
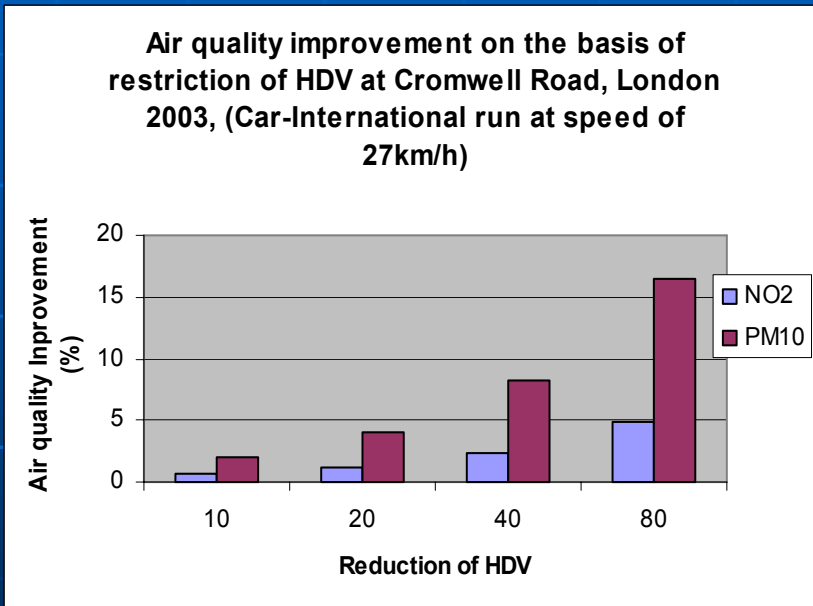


Annual means

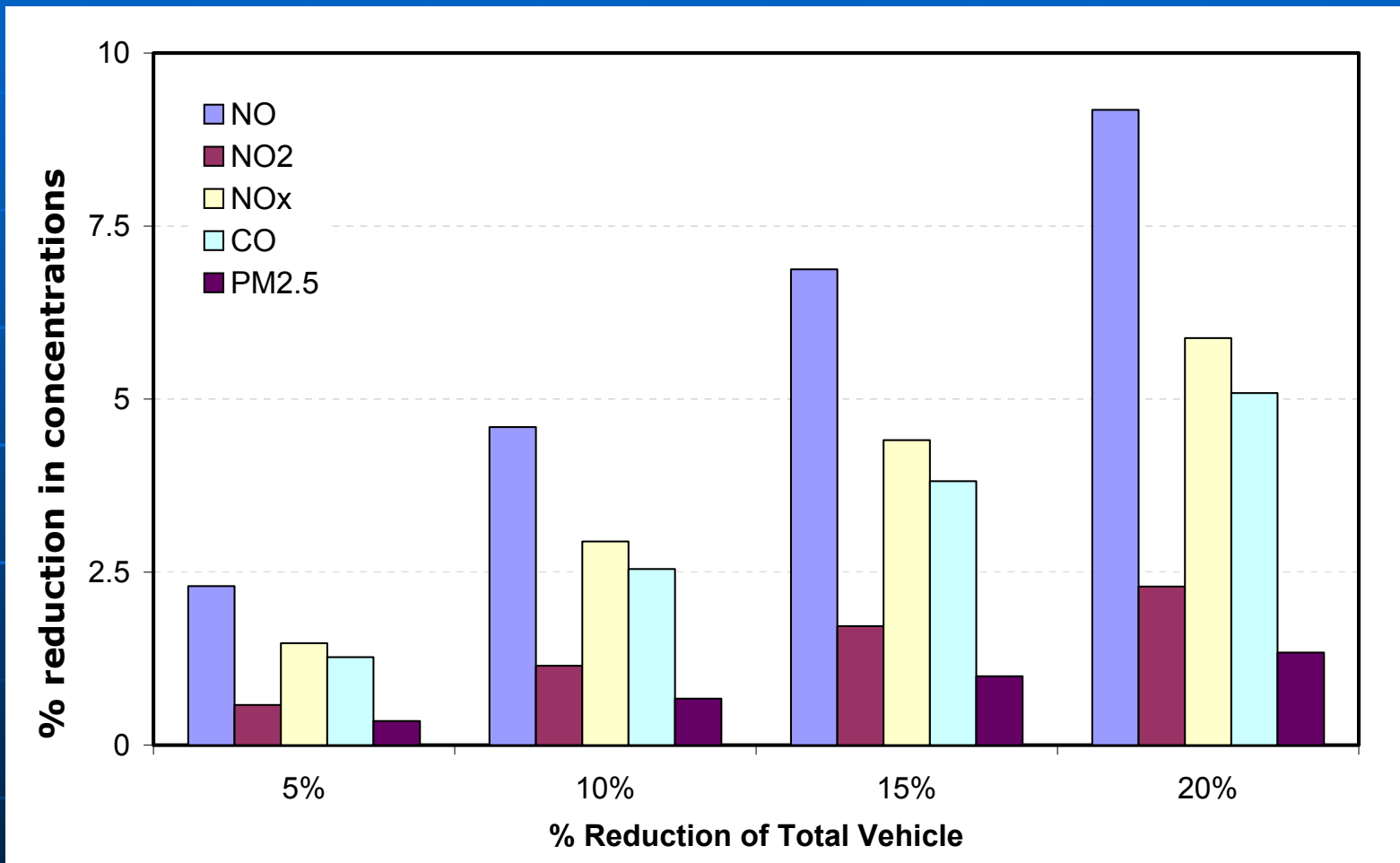
Traffic Management Scenario Analysis with the OSCAR System



Air quality improvement based on the restriction of HDV at Cromwell Road, London 2003



Changes of AQ Concentrations at *Cromwell Road* resulting from reduction in total vehicle (Hourly Average, 2003) – CAR-FMI



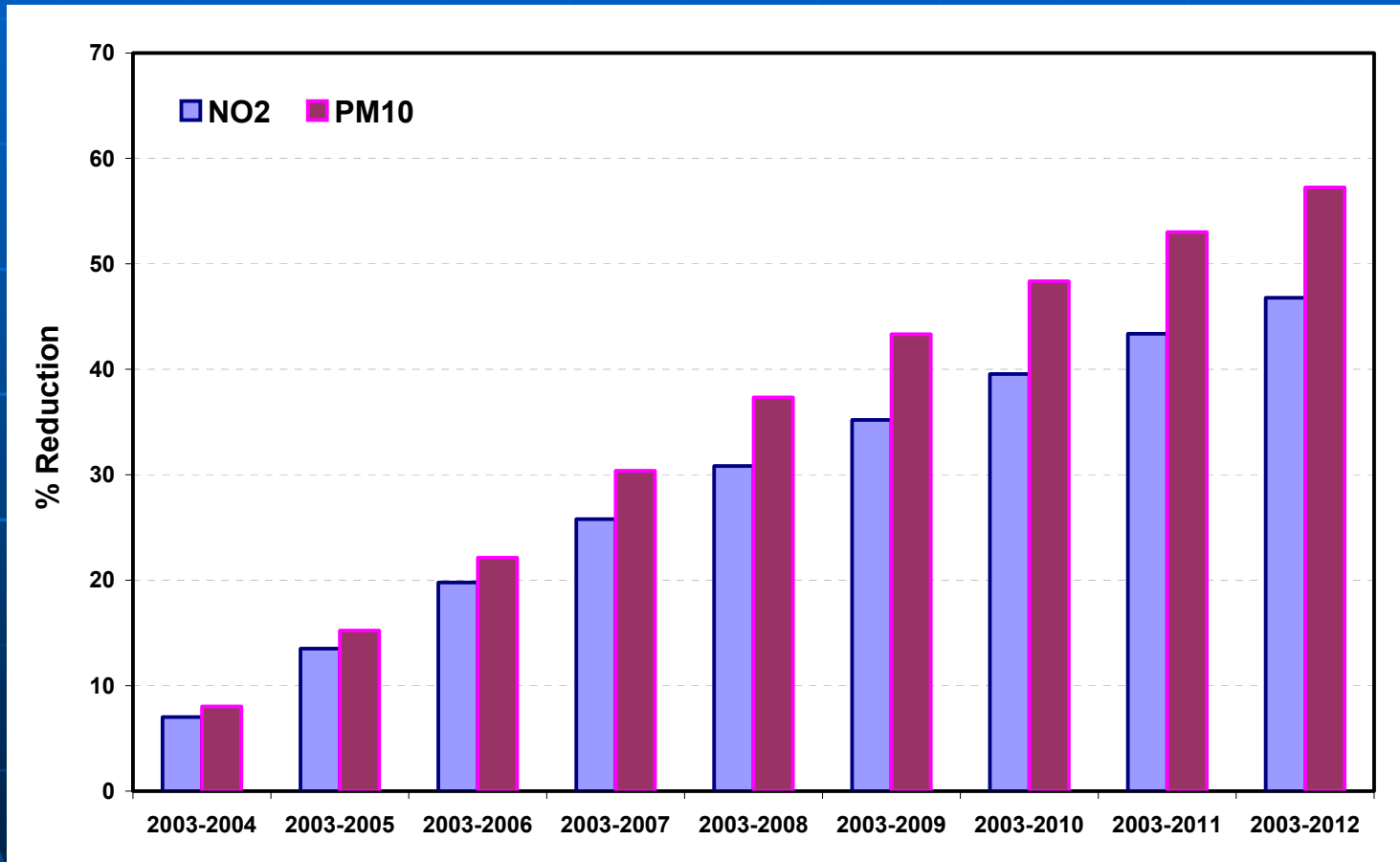
Example for Cromwell Road 49 Links (NO_x Concentrations)

GIS display of NO_x
concentrations



Marylebone Road Air Quality Projections in OSCAR

Reduction in street increment of annual NO₂ and PM₁₀ concentrations from 2003-2012 using CAR-II

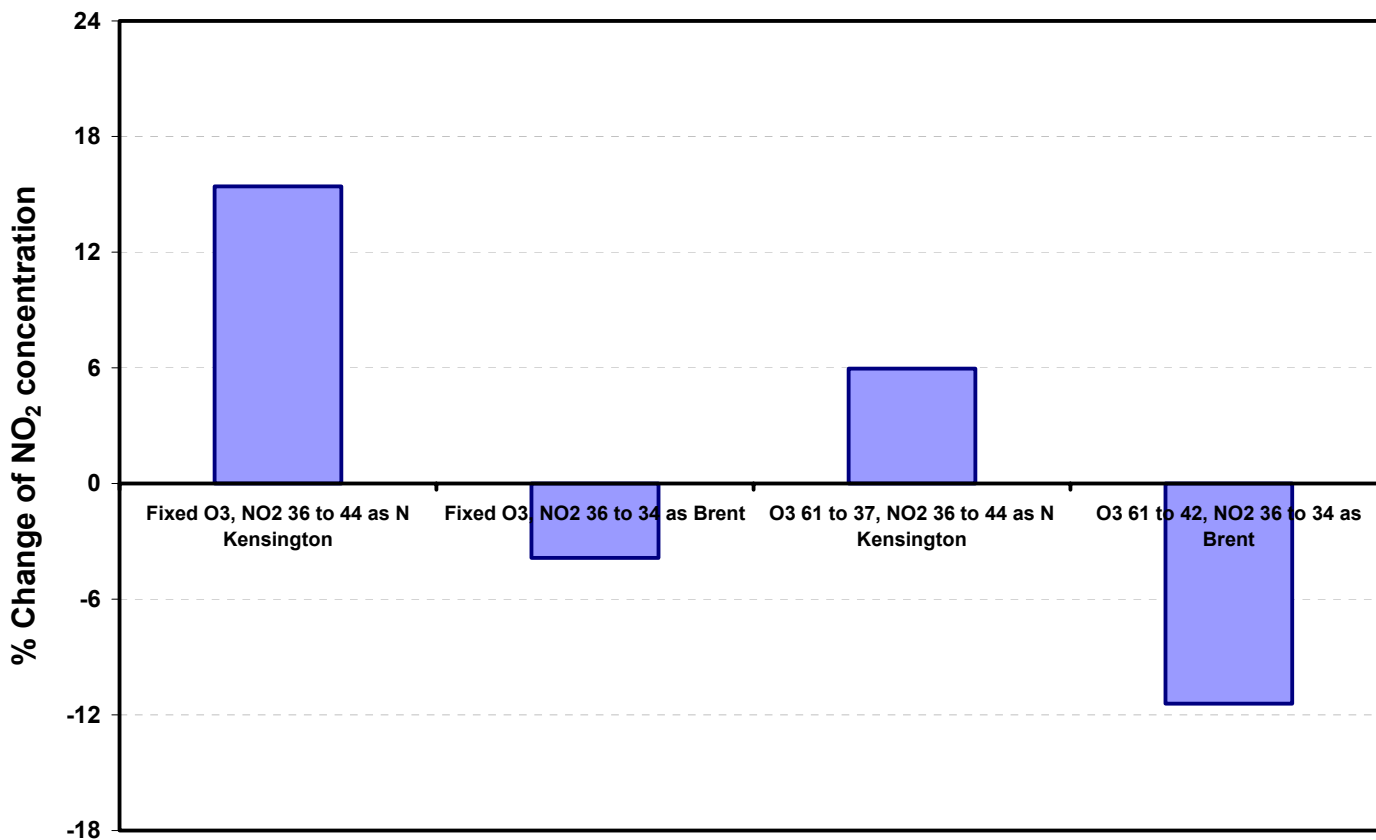


Sensitivity to BG Concentrations

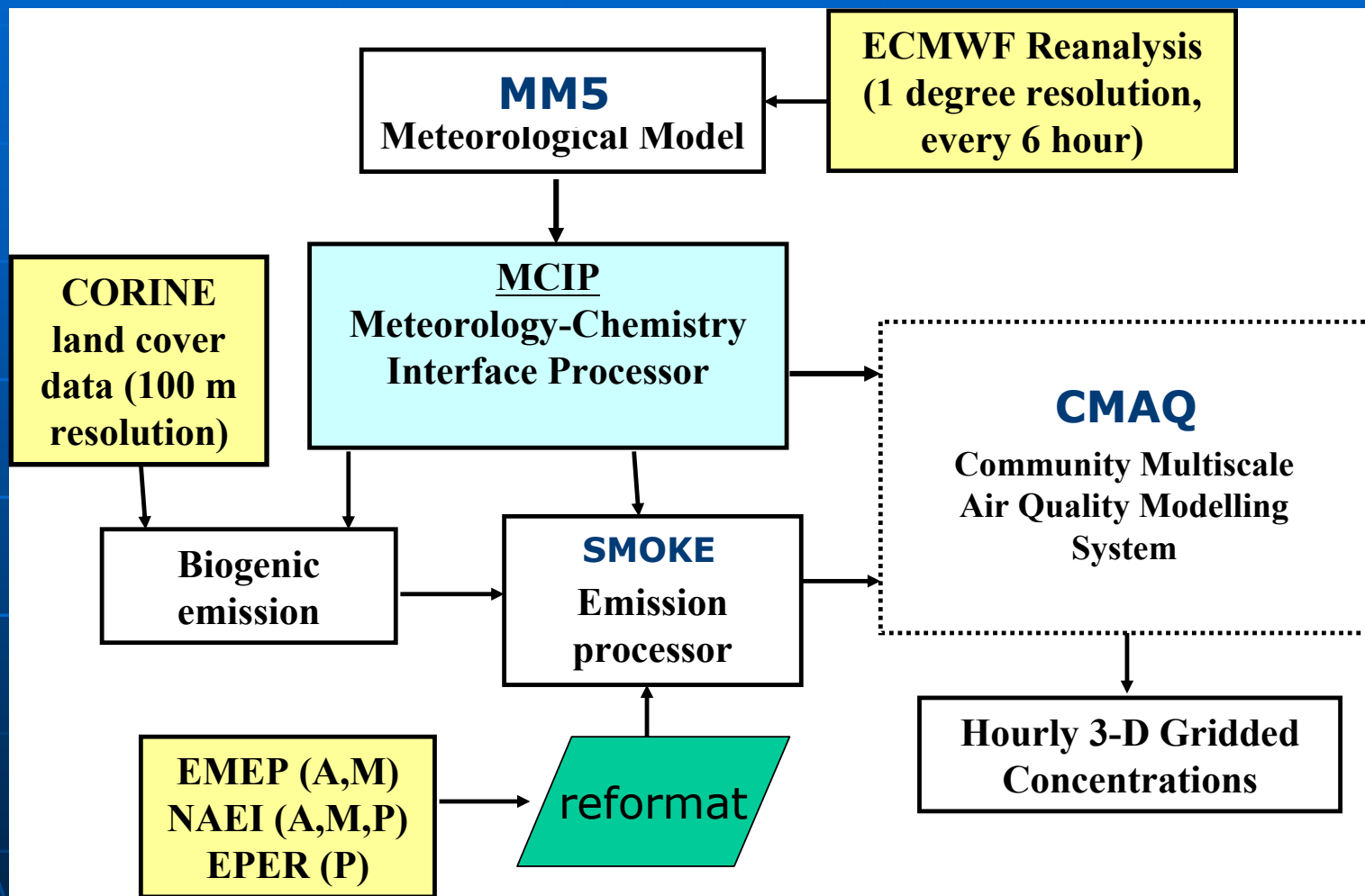
Case study	O3 BG (ug/m3)	NO2 BG (ug/m3)
1. Base case 2003	61	36
2. NO2 from N Kensington	61	44
3. NO2 BG from Brent	61	34
4. O3 and NO2 from N Kensington	37	44
5. O3 and NO2 from Brent	42	34

Sensitivity to BG Concentrations CARII

Base case BG Concentrations of O₃ is 61 ug/m³, NO₂ is 36 ug/m³



- To demonstrate the use of advanced 3-D air quality models as a tool for assessing the potential contribution of industrial emissions to near surface pollutant levels under different meteorological conditions



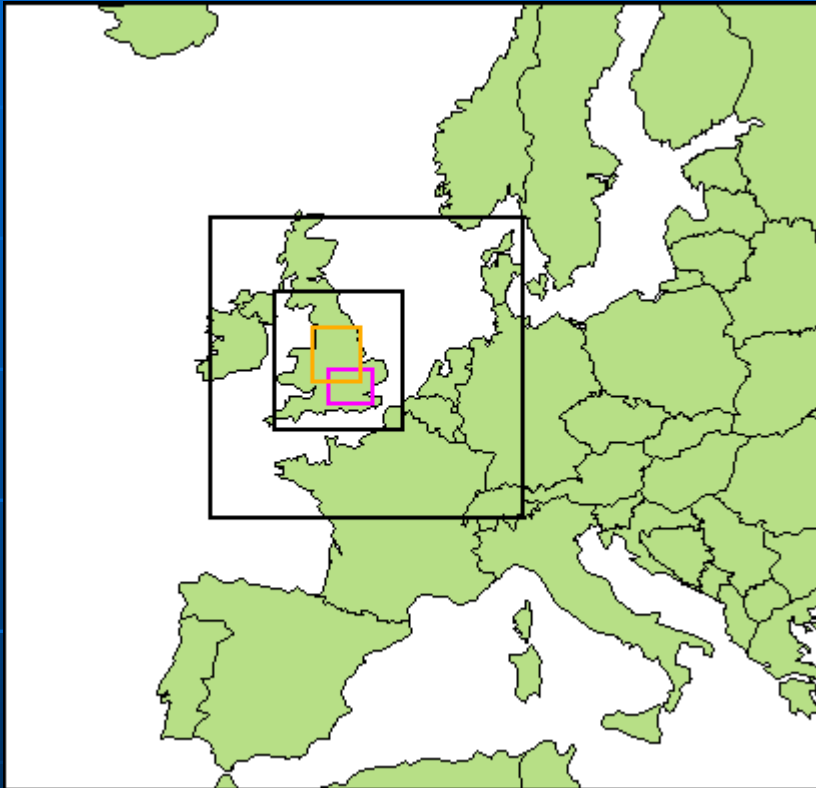
Experiment design

- Simulation periods (two episodes):
 - a. 12 UTC 22 Jun -12 UTC 28 Jun 2001: Summer O₃ and NO₂ episode
 - b. 00 UTC 09 Dec – 00 UTC 15 Dec 2001: Winter NO₂ episode

Exp.	Input Emissions	Period
A	Base case, All emissions	a, b
B	Remove emissions from all UK point sources	a, b

Contribution from point sources = A-B

CMAQ Model Configuration



26 vertical layers

 Dec. 2001

 For June 2001

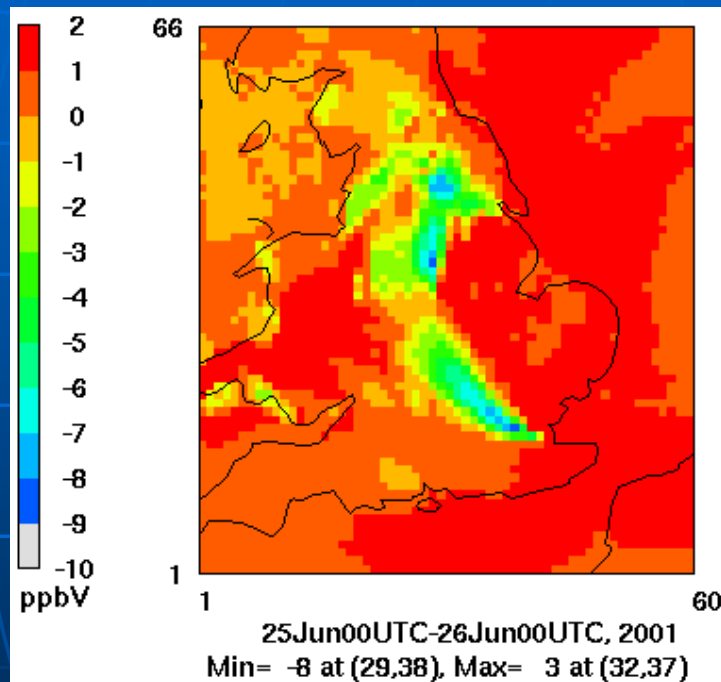
Initial and boundary conditions:
 Monthly averaged concentrations of species from global 3-D chemical-transport model STOCHEM
Chemical mechanism: CB-IV

Grid	Δx (km)	N_x	N_y
1	81	42	42
2	27	48	48
3	9	60	66
4	3	60/72	54/88

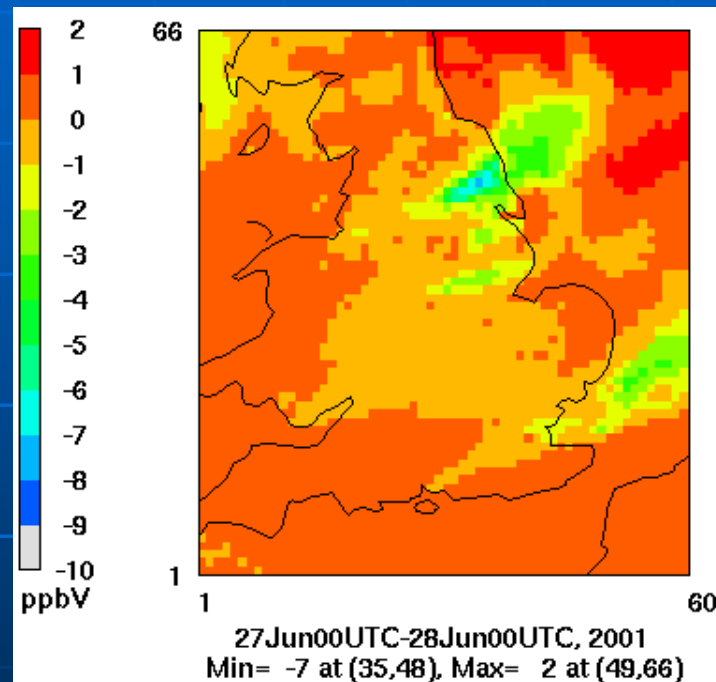
Contribution of UK industrial point sources to near surface O₃

$[O_3]_{exp.A} - [O_3]_{exp.B}$ (June 2001)

High pollution day



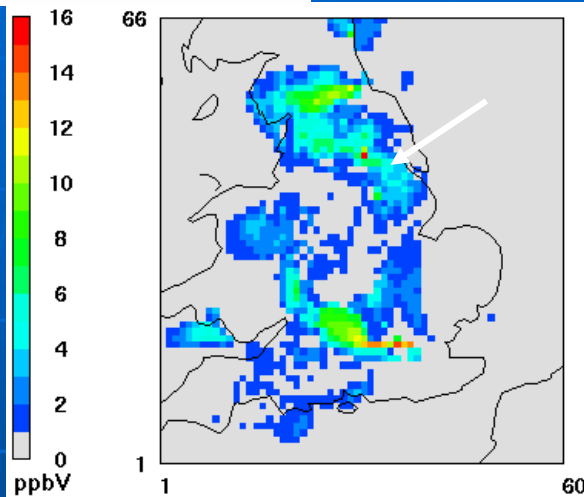
Normal pollution day



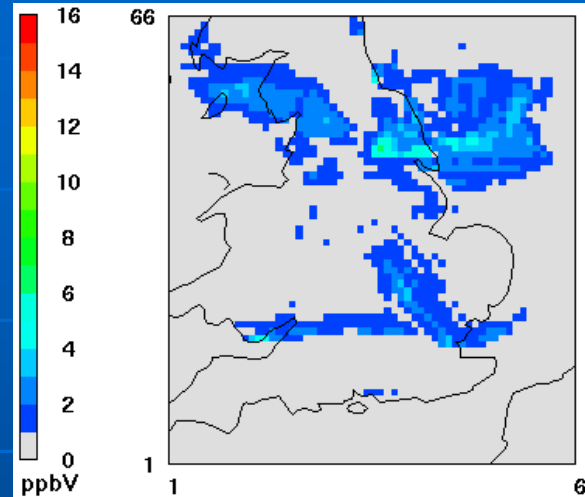
daily maximum 8-h running mean

Contribution of UK industrial point sources to near surface NO₂ (Daily maximum NO₂)

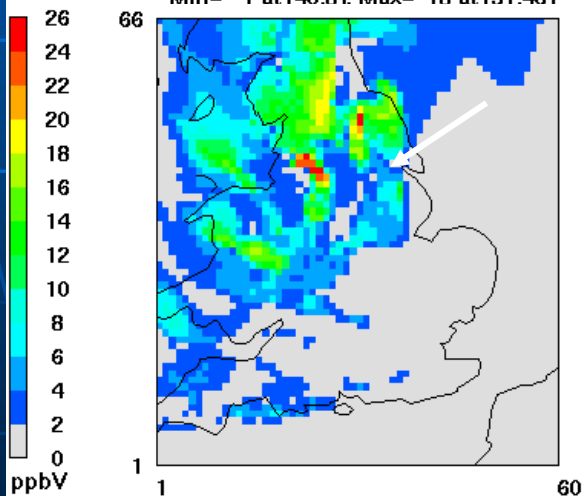
June 2001



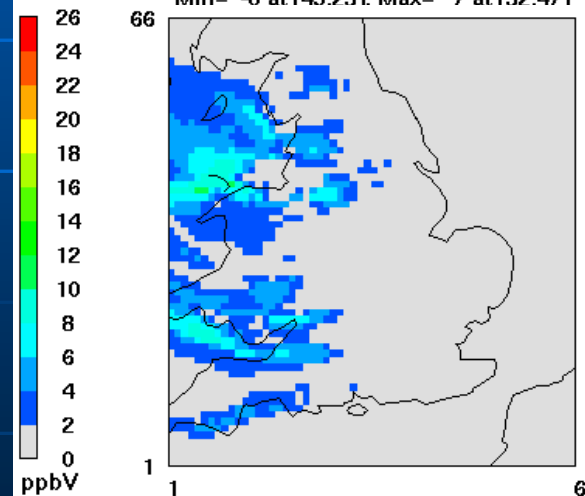
25Jun00UTC-26Jun00UTC, 2001
Min= -1 at (40.8), Max= 18 at (31.46)



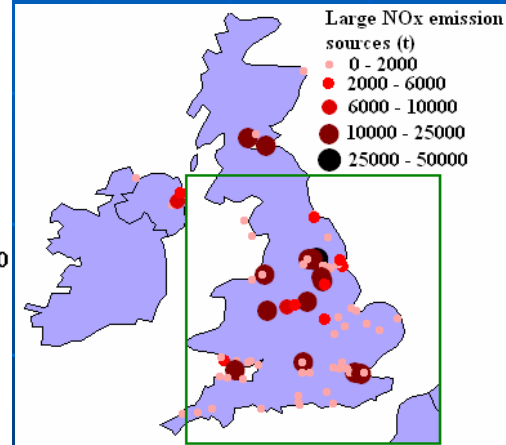
27Jun00UTC-28Jun00UTC, 2001
Min= -0 at (45.23), Max= 7 at (32.47)



11Dec00UTC-12Dec00UTC, 2001
Min= -1 at (38.44), Max= 28 at (23.46)



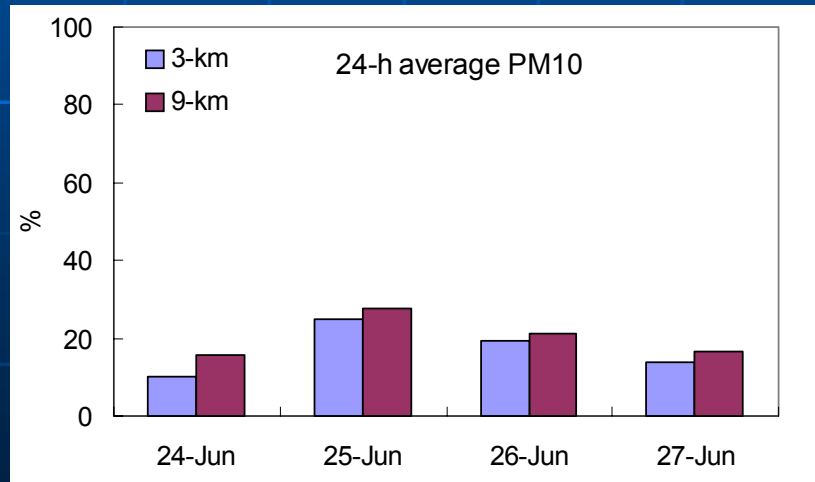
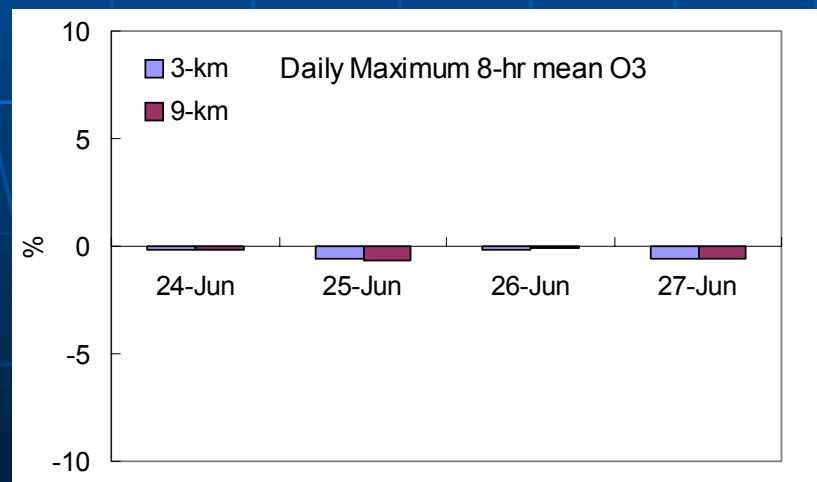
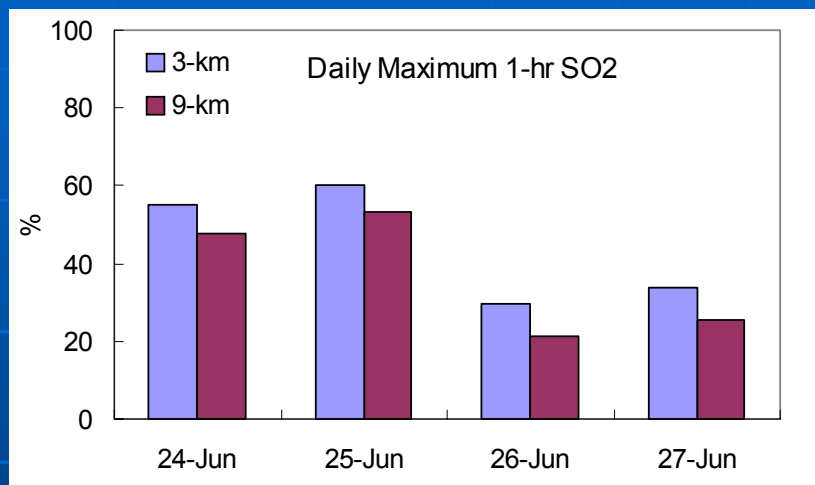
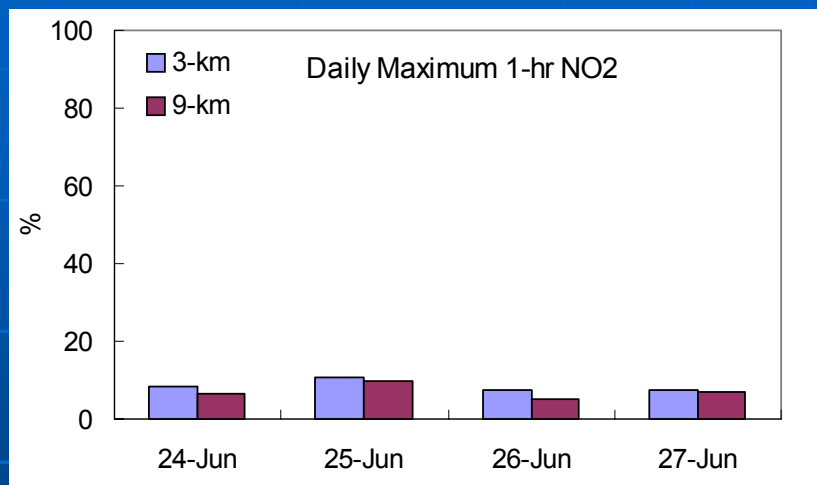
13Dec00UTC-14Dec00UTC, 2001
Min= -1 at (27.61), Max= 10 at (6.41)



Green box marks the area shown on left.

Dec. 2001

Percentage contribution of all UK point sources to near surface pollutant concentrations (averaged over domain 4)



Conclusions

- Assessment models should be fit for the purpose
- Multi-model approach is often necessary for assessment
- Models should be evaluated for situations which are similar to the applications of interest
- Where possible use consistent set of input data for models
- Background stations should be chosen carefully
- Advanced modelling approaches (eg nested Eulerian models) should be used for detailed assessments involving complex physical/chemical interactions over multiple scales