

Buncefield: National monitoring, emissions and data activities



22nd June 2006


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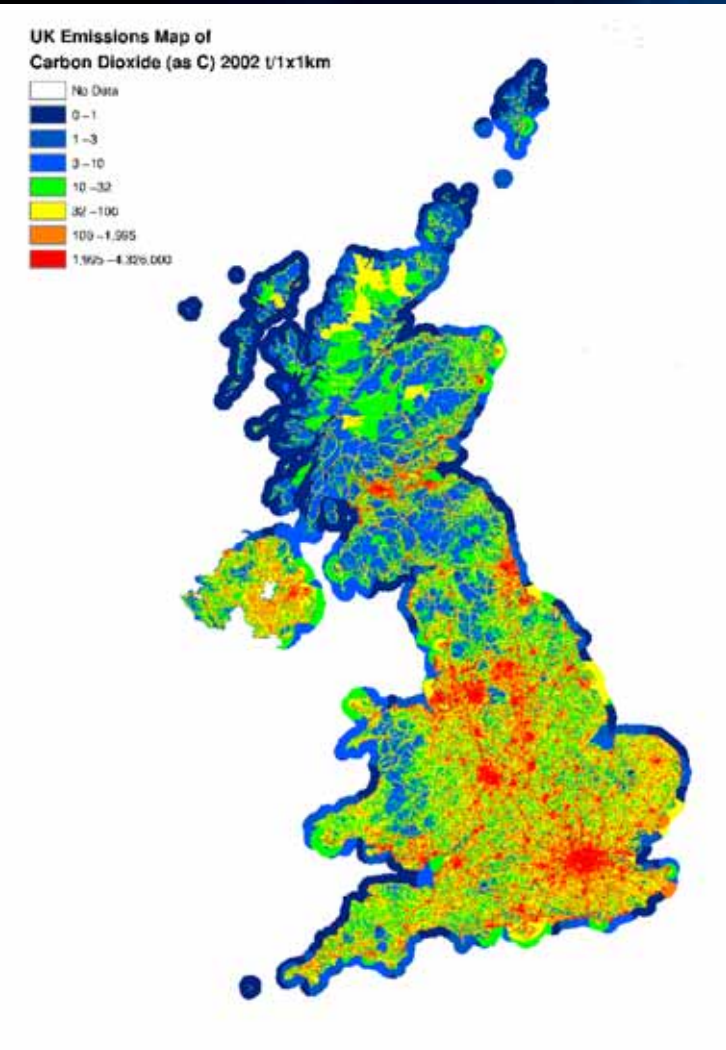
Introduction to the Big Bang

- On Sunday 11th of December 2005, there was a major explosion at the Buncefield Oil Depot near Hemel Hempstead, north of London
- The depot is an important regional distribution terminal storing oil, petrol and kerosene
- It supplies airports across the region, including Heathrow and Luton
- The explosion- at 06:00 – was heard up to 40 miles away
- The fires were the largest in Europe since WW2; they were finally extinguished on 14 December
- This talk examines major Netcen activities which followed the explosion

Much of our work during the Buncefield incident was related to ongoing national programmes for Defra and the DAs...

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- The National Atmospheric Emissions Inventory (NAEI) → ■ Buncefield Emission Estimates
 - The national monitoring networks → ■ Locally targeted monitoring
■ Analysis of AURN & other data
 - The UK Archives and forecasting → ■ Public and technical information dissemination
■ AQ report on the incident

Netcen is responsible for the UK National Atmospheric Emissions Inventory (NAEI)



- Covers air quality emissions data collected since 1987 on NO₂, PM₁₀, black smoke, SO₂, CO, VOCs, CH₄, NH₃, Pb, CFCs, halogens, heavy metals and Greenhouse Gases.
- Web-enabled at www.naei.org.uk
- Analyses and estimates emission statistics from wide variety of sources to map national emissions on a disaggregated 1 x 1km basis
- Projections of emissions for SO₂, NO_x, CO, NMVOCs, selected POPs, GHGs and heavy metals.
- A major tool for UK policy-making over the last two decades, as well as supporting industry and LAs

Estimated emissions from the fires



- Estimated using NAEI methodologies
- Emission factors from NAEI and EMEP/Corinair used
- 4 scenarios evaluated- these figures are from 'realistic' scenario- 90% of fuel from BPA and 60% from HOSL terminals combusted
- This amounts to ~56kTonnes of fuel
- Many uncertainties, and figures remain provisional at this time...

Pollutant	Est. Buncefield Emissions *	UK Total (2003)*	Buncefield/UK %
NO2	37.2	1570	0.0024
PM10 *	8249.5	141	5.8507
PM2.5 *	4949.7	86.9	5.6958
Dioxins	1.32	259	0.5087
B[a]P *	285.4 (kg)	4034	7.0761
CO	1712.7	2768	0.0619
NM VOC	101.0	1089	0.0093
Arsenic	-	16.1	-
Cadmium	-	5.5	-
Mercury	-	7.4	-
Lead	-	133	-
Benzene	58.3	13.6	0.4290
CO2	0.177 (MT)		

* Tonnes unless otherwise indicated

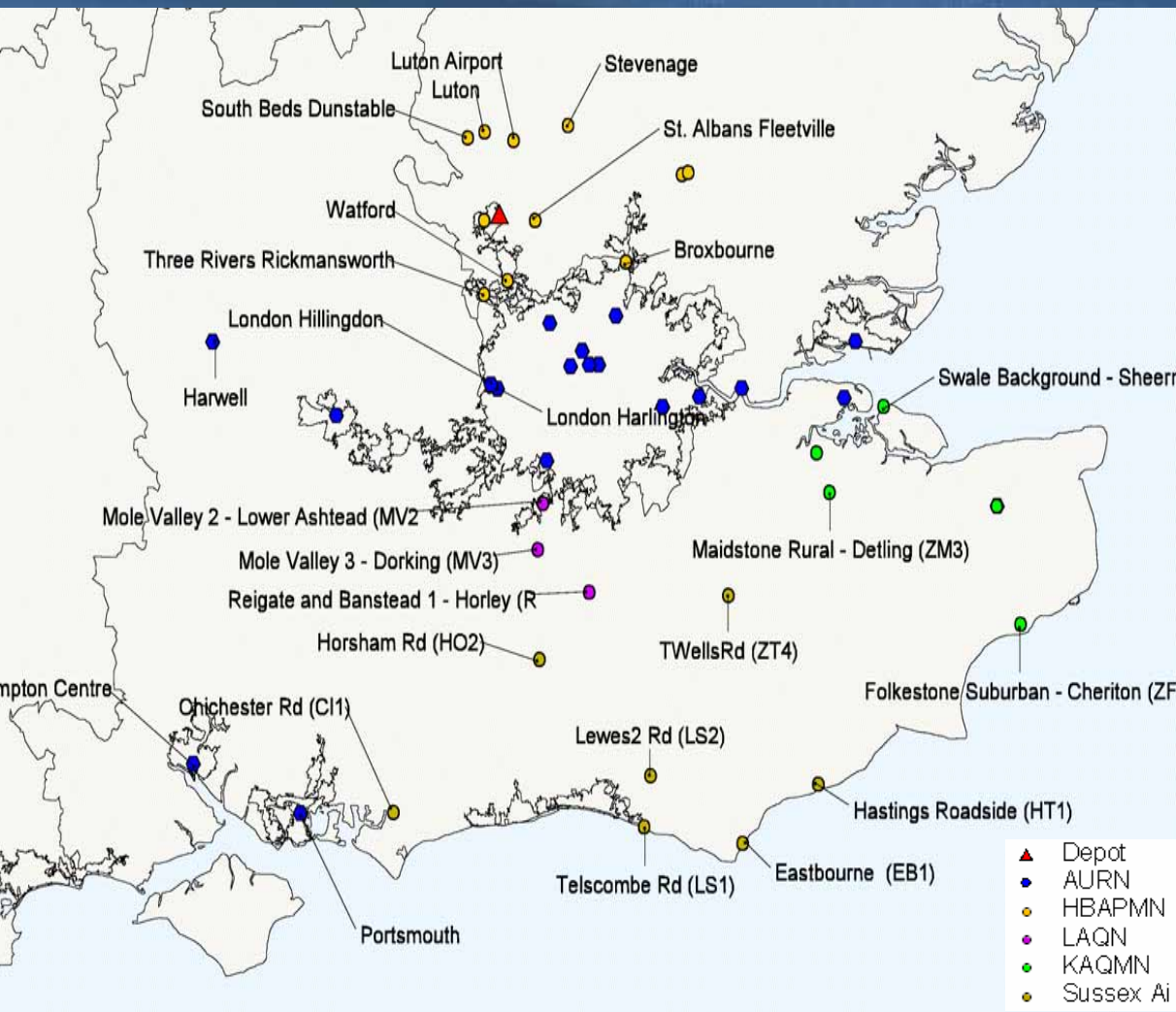


Netcen role in UK monitoring networks

- There are 11 UK national networks
- These currently comprise over 130 automatic and 1500 sampler-based stations
- **Netcen** manages or quality assures a number of these programmes
- Of particular relevance to the Buncefield incident is our role as QA/QC manager of the AURN and manager of VOC, PAH networks



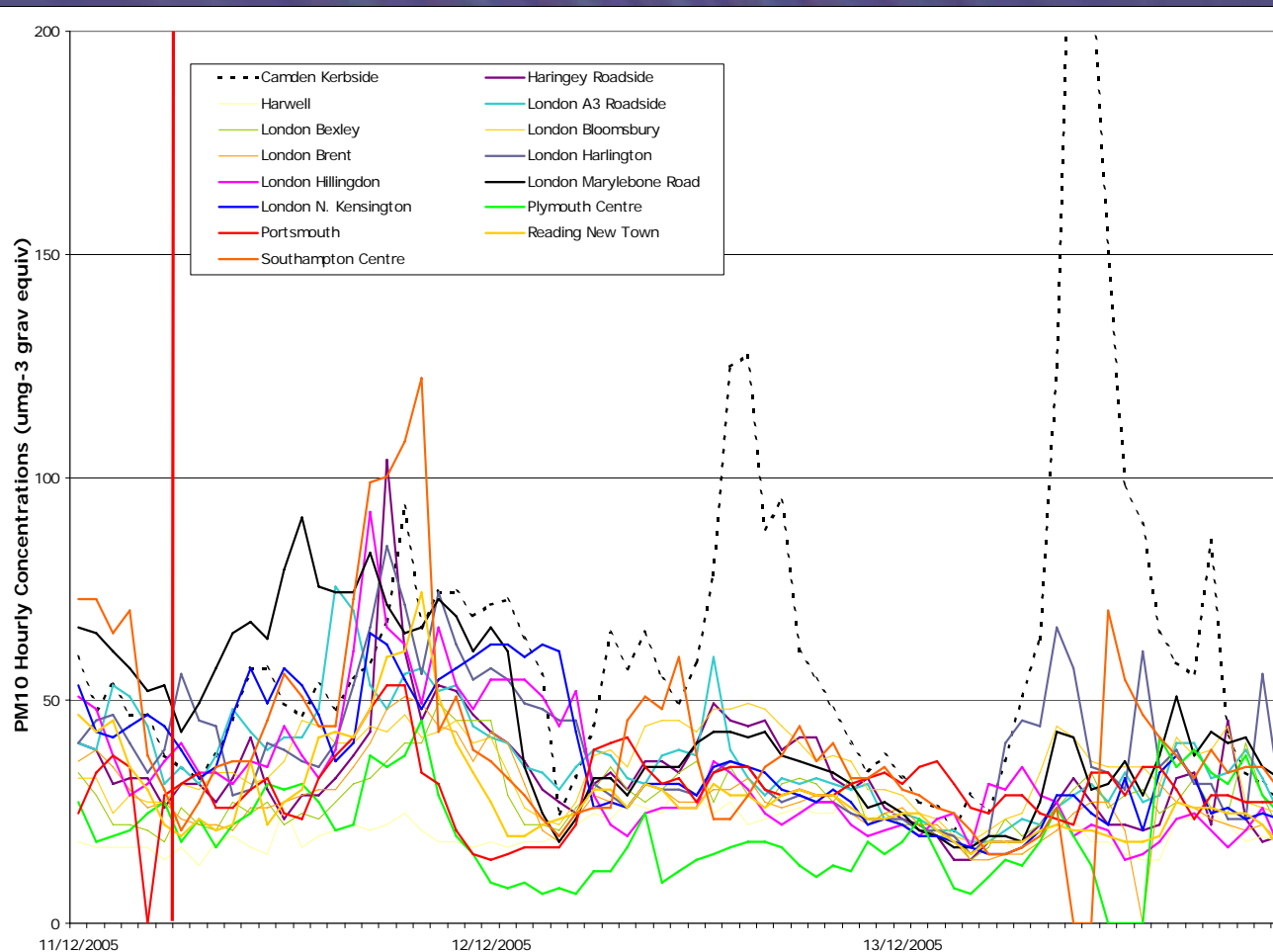
Lots of networks activity in SE England!



(notes- map includes PM_{10} monitoring stations across SE; London Network not fully represented; does not include PAH measurement sites)

- The national AURN, VOC and PAH networks continued throughout the fires
- ~ 155 sites with > 50 in region
- Hourly results from the AURN disseminated in near real-time through the UK Air Quality Archive at www.airquality.co.uk.
- Highlights of the national network measurements are considered here.
- Results from regional air quality monitoring networks in south-east England – including the LAQN- will be discussed in the next talk

AURN PM10 data

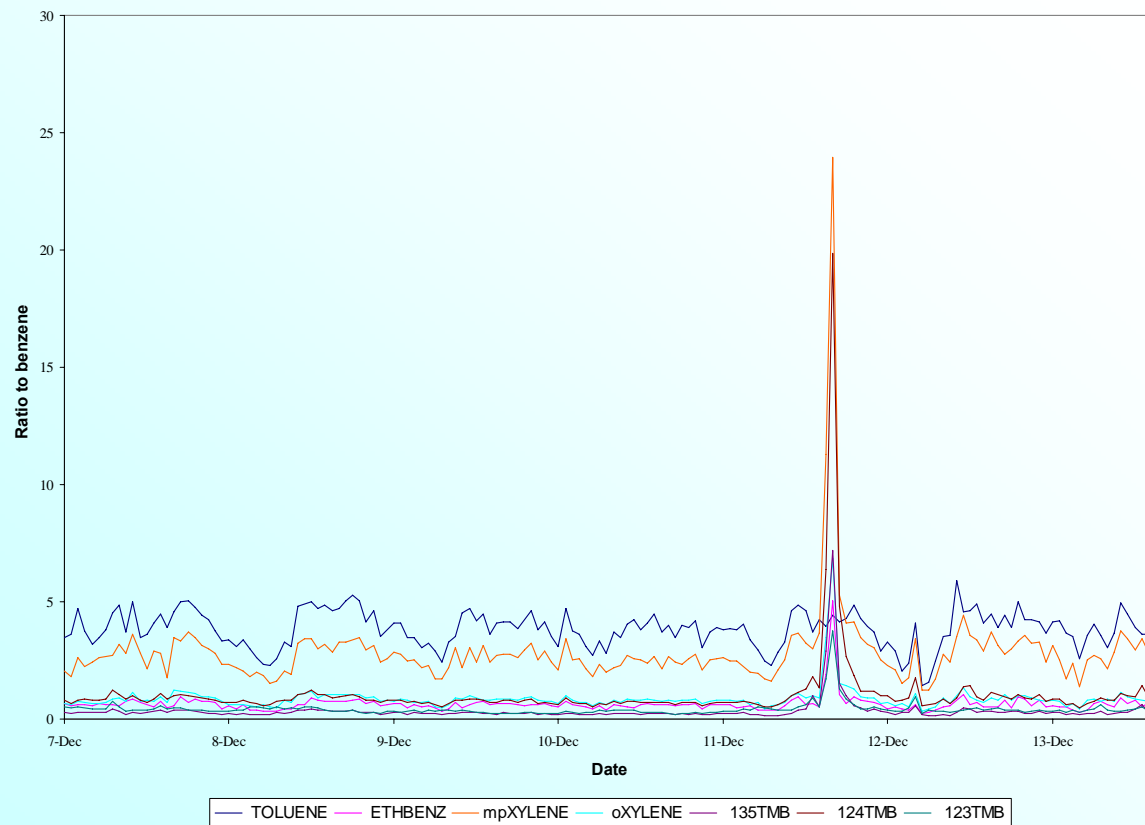


Highest AURN PM10 hourly measurements

- Only at one site- Bradford Centre- were 24h PM10 levels in the AURN over AQI of 'Moderate' ($50-75 \mu\text{g}/\text{m}^3$ TEOM) during the fires
- This was directly attributable to local construction work
- Sites measuring 'Moderate' AQIs from 9th to 16th (Camden, Haringey, Marylebone) all consistent with local traffic influence
- Highest AURN hourly datasets during the incident shown here-
- Most below $100 \mu\text{g}/\text{m}^3$, max of $150 \mu\text{g}/\text{m}^3$

National VOC network data

- London Marylebone is closest Hydrocarbon network station to Hemel Hempstead
- Levels unexceptional..
- **BUT** ratios to benzene show a spike for toluene, xylene and trimethylbenzenes on the 12th
- This is the only unusual observation, although absolute levels not high
- Ratios broadly consistent with evaporative emissions of fuel...
- But different to those collected by grab sampling near to fires



Ratios of individual aromatic hydrocarbons to benzene at London Marylebone Road- 7th to 13th December

PAH network data

- Levels all go up during the week of the fire
- **BUT** we know very little about week-on-week variations of these species
- So this could be just 'noise' in the signal
- Lack of consistency in individual concentration PAH and dioxin profiles and ratios actually suggests different causation at the 3 sites

Dioxins fg TEQ/m³

	<i>Brent</i>	<i>London</i>	<i>Bromley</i>
<i>22-8/12</i>	34	13-25	18
<i>8-14/12</i>	54-55	30-34	33-34
<i>14-22/12</i>	49-50	18-23	23-25

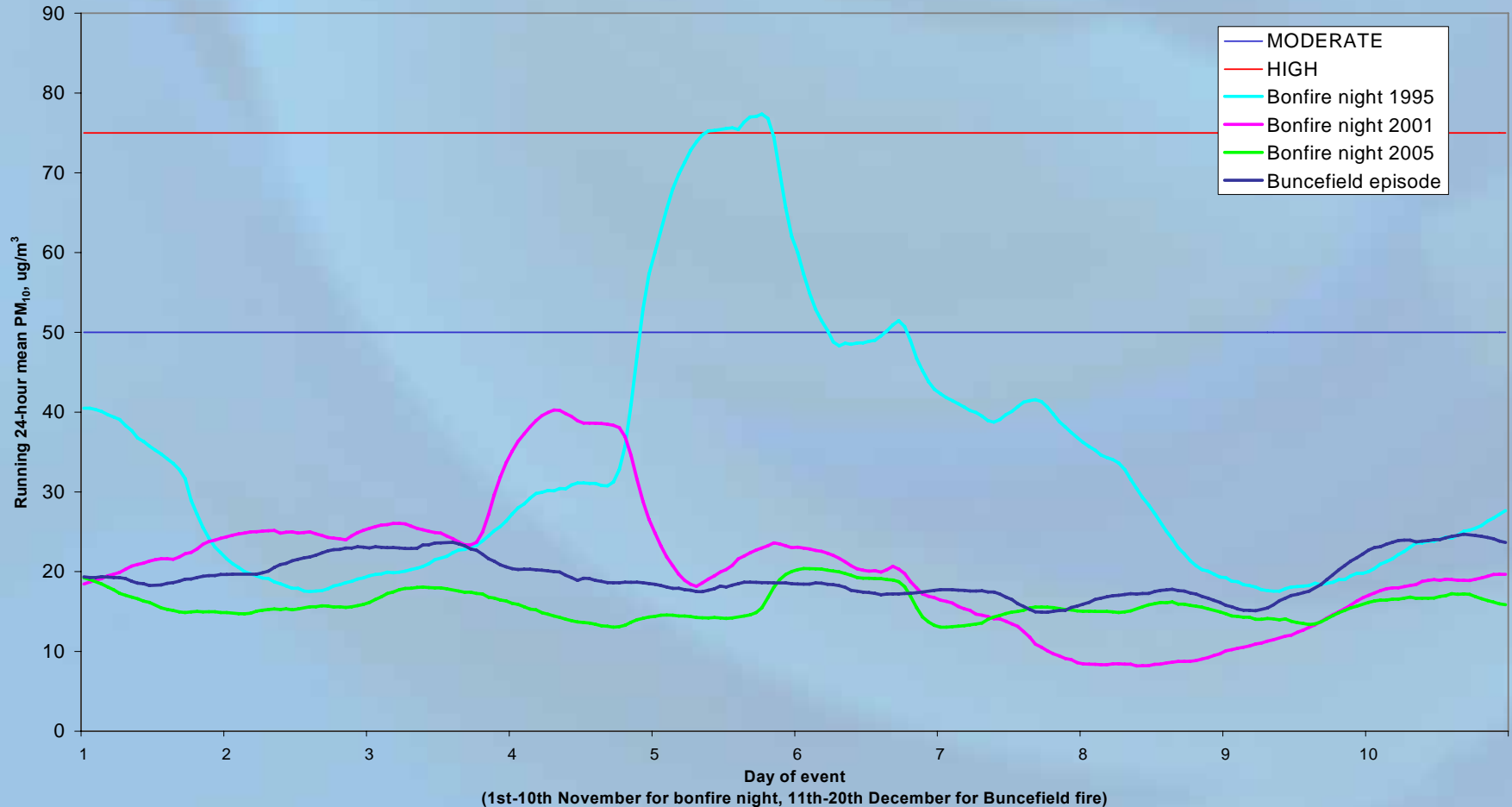
PAHs total ng/m³

	<i>Brent</i>	<i>London</i>	<i>Bromley</i>
<i>22-8/12</i>	38	85	61
<i>8-14/12</i>	74	119	53
<i>14-22/12</i>	51	100	40

Benzo[a]pyrene ng/m³

	<i>Brent</i>	<i>London</i>	<i>Bromley</i>
<i>22-8/12</i>	0.16	0.30	0.23
<i>8-14/12</i>	0.60	0.57	0.31
<i>14-22/12</i>	0.36	0.46	0.20

Putting Buncefield into context: comparison with recent firework nights...



Running 24hr average PM₁₀ concentrations ($\mu\text{g}/\text{m}^3$, TEOM) in the AURN during the Buncefield fire and during recent 'high' (1995), medium (2001) and low (2005) Bonfire Nights



Turning air quality data into information during the Buncefield Incident



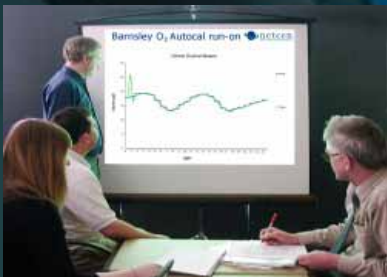
Step 1: Measurement- collect data

Raw Data



Step 2: QA/QC- data validation

Reliable Database



Step 3: Analysis & interpretation

Information

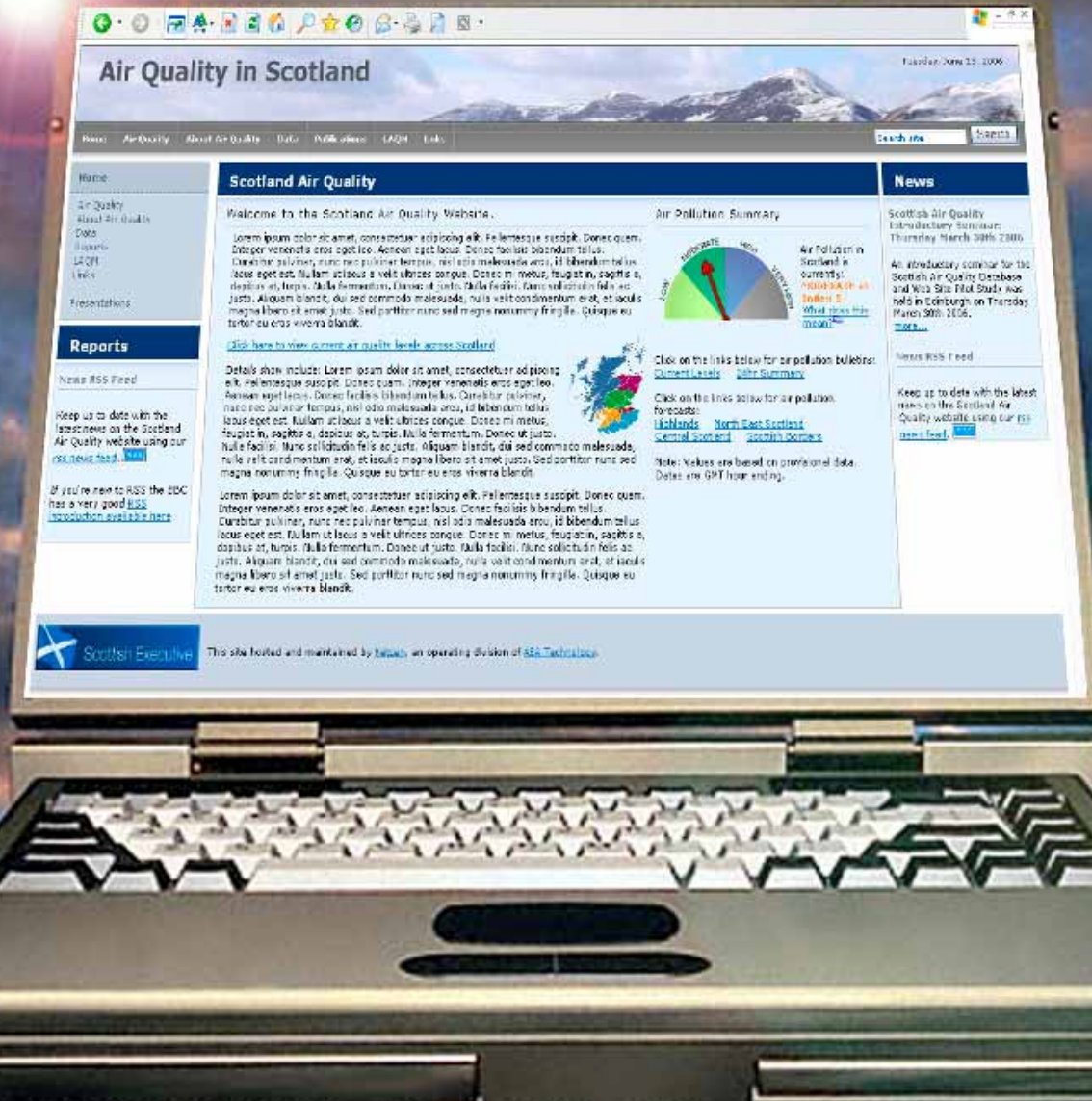


Step 4: Reporting & dissemination

Use

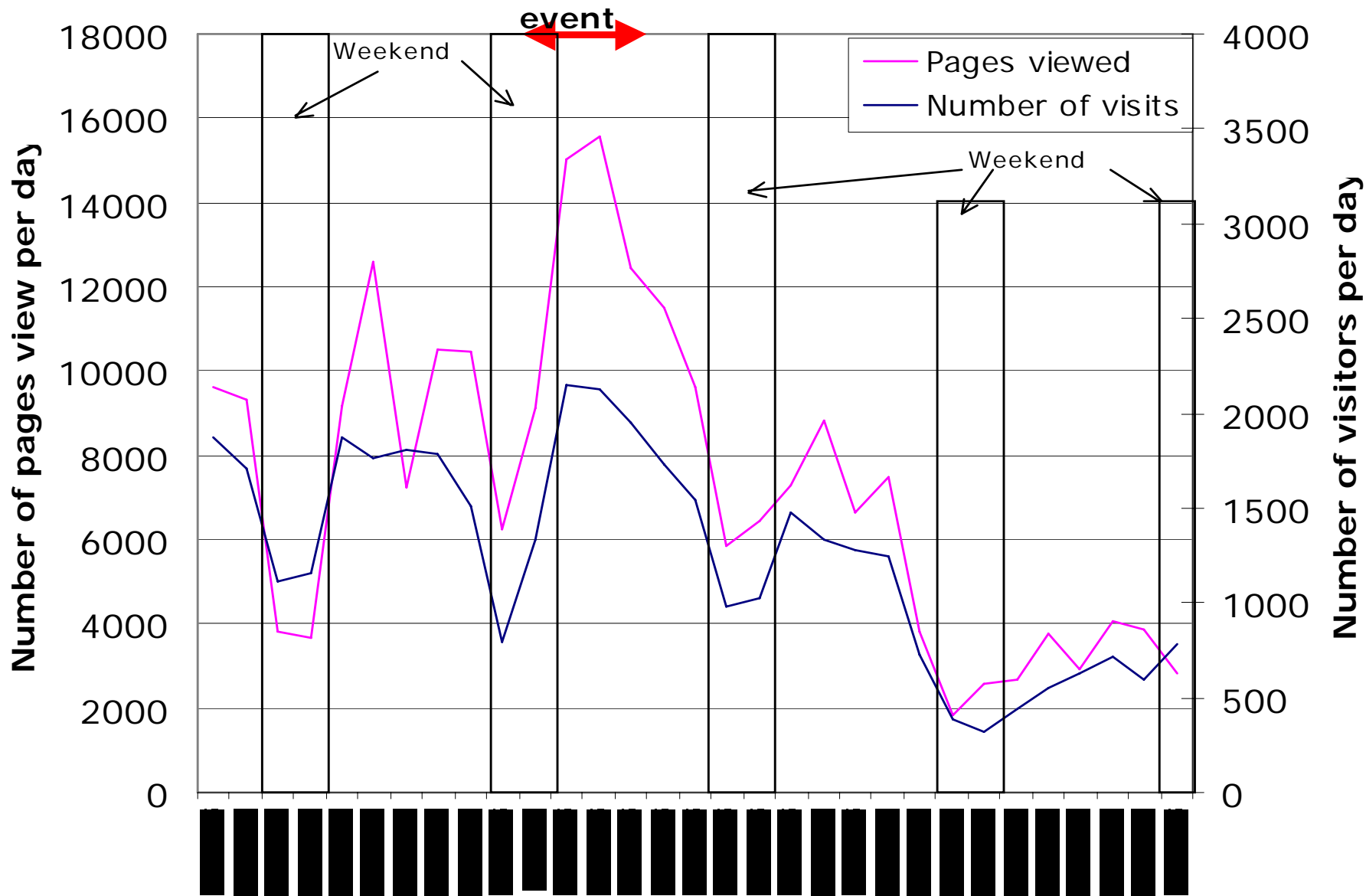
Air quality updates rapidly and publicly available from a family of UK on-line resources

The
Scottish
website

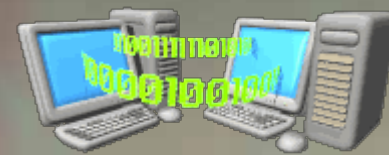




Increased hits on the UK Archive website during the Incident...



The UK Archive bulletin service



- A free alert service that you can sign up to at the UK air quality website:

http://www.airquality.co.uk/archive/bulletin_reg.php

- Once registered, you will receive customised email bulletins including:

Measurements: Summary of last 24-hours or last hour's air quality measurement data.

Forecasts: Daily updated regional forecasts for up to 24-hours ahead of UK air pollution concentrations.

Alerts: If the Alert Threshold in an Air Quality Daughter Directive is exceeded, then an alert is issued.

- This service proved especially popular during the Buncefield incident!

UK Forecasting- Primary Objectives

- Twice-daily forecasts routinely issued to Teletext, Free-Phone and the Air Quality Archives.
- Bi-weekly e-mail forecasts go to a wide circulation of recipients, including AURN stakeholders.
- Forecasts designed to inform the UK public so that they can take appropriate measures.
- Also meet the requirements of European Directives on Air Pollution by ozone, sulphur dioxide and nitrogen dioxide.



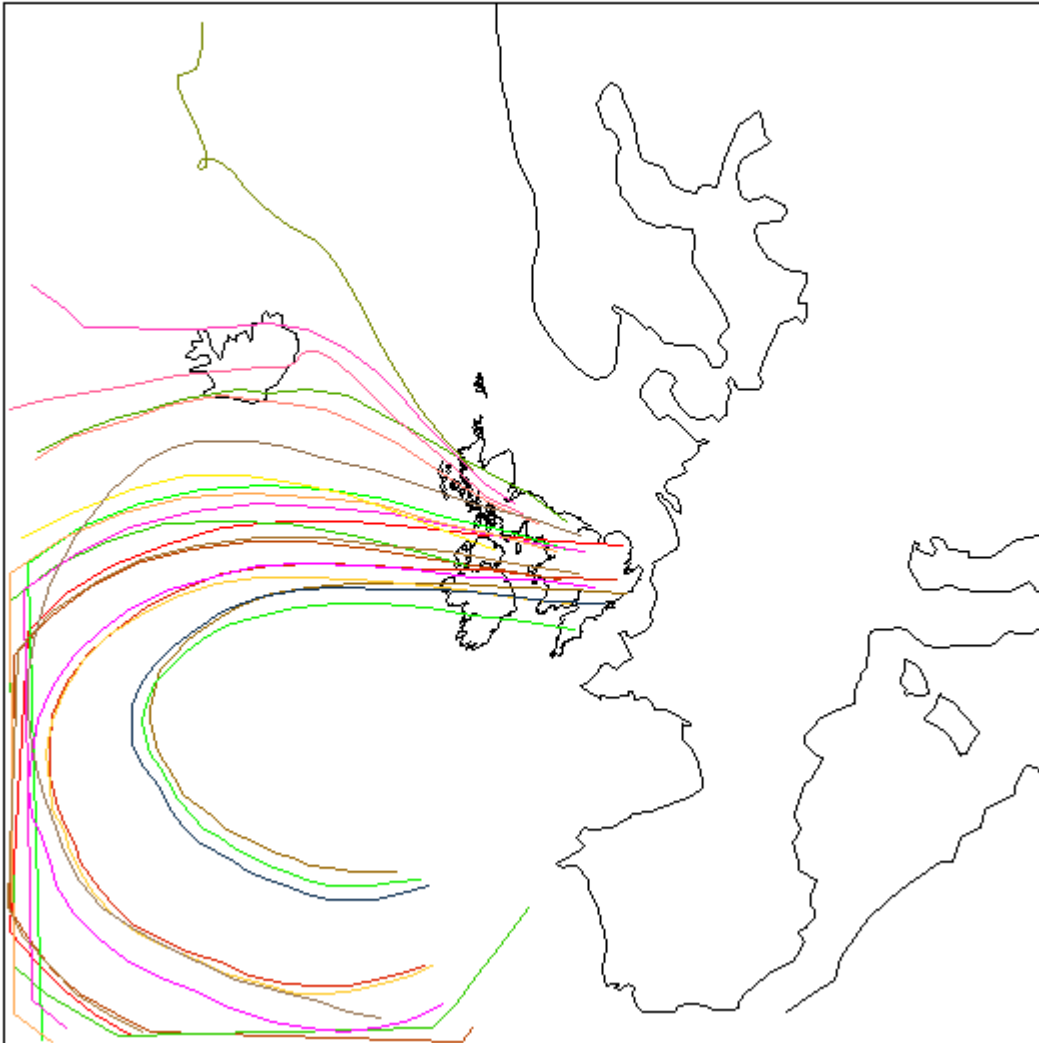
During Buncefield



- During the fires, national air quality forecasting of air quality continued with duty air quality forecasters at Netcen undertaking ongoing checks on monitoring data from the AURN and other air quality monitoring networks.
- An additional 9:00 am forecasting update was added.
- Close liaison with the Met Office's Environmental Monitoring and Response Centre (EMARC) was maintained during the event, in order to obtain up-to-date weather reports and the latest information on model predictions of plume dispersion
- Back trajectories produced to assist the forecasts during the period are shown in next slide..

Netcen 1000mB 96-hour back trajectories over period

Airmass back trajectories for 96 hours
upto 12:00 16-12-2005



- Produced routinely as part of forecasting contract
- Use Met Office numerical prediction models
- Trajectories show change in weather pattern on 11th- from recirculation to Atlantic influence
- This, combined with cold, stable layering and high plume buoyancy strongly influenced impacts of the fires
- More on this later...

Major Buncefield report published on 9 May

- Produced as part of the ongoing Defra Archive contract
- A major collaboration with Met Office and the Health Protection Agency
- Definitive assessment of air quality impacts of the fire
- Includes:
 - Emission estimates
 - Broad range of monitoring (national networks, local networks and targeted local campaigns)
 - Modelling undertaken during and after the fires
- Available to download from Defra website and UK Archive-
www.airquality.co.uk

Initial review of Air Quality aspects of the Buncefield Oil Depot Explosion

A report produced for the Department for Environment, Food and Rural Affairs, the Scottish Executive, the Welsh Assembly Government and the Department of the Environment in Northern Ireland



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Conclusions

- The fires produced emissions of a range of pollutants, particularly particles and B[a]P
- However, measurements from national monitoring networks did NOT show significant ground level impacts in southern England
- PM levels were generally LOW, although some sites showed MODERATE levels due to nearby traffic; one was HIGH due to local construction work; no elevated levels were attributable to the fires
- VOC levels not elevated in London (though some unusual ratios to benzene exhibited)
- PAH levels in and around London rose, though this cannot readily be attributed to the fires
- Hourly air quality data updates and regular forecasts were available online throughout the incident
- Full written report on air impacts now released

**Thank you-
any questions?**

