

UK Air Pollution Forecasts

Tuesday April 15th 2003

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Today's Presentation



- Some Background Information.
- Compiling Air Quality Forecasts.
- Dissemination.

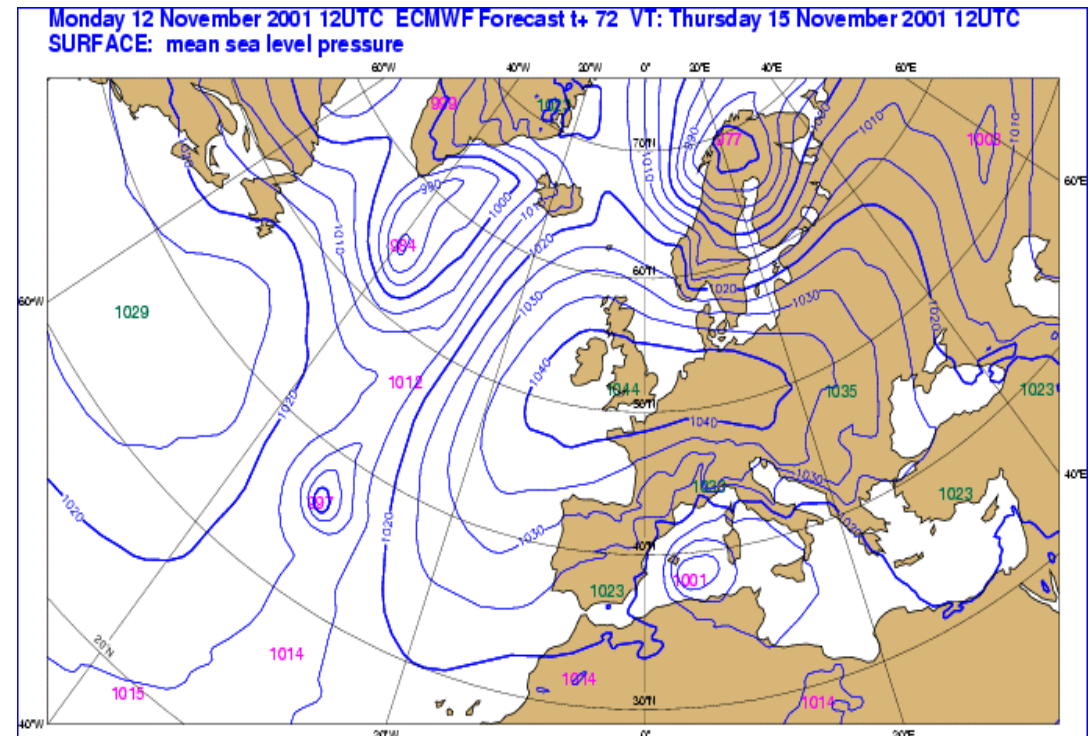


Forecasting Objectives

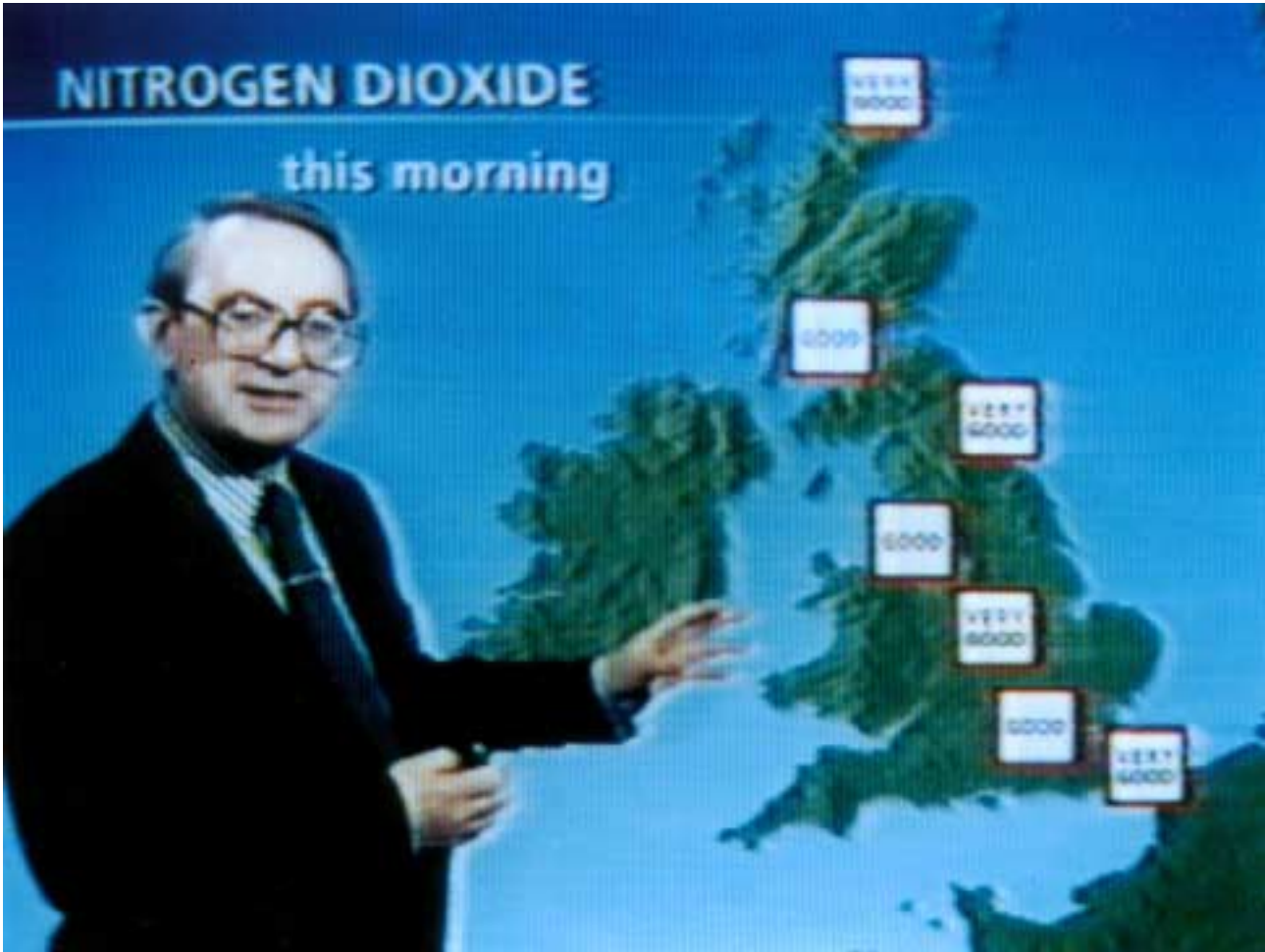
- To inform the UK public about air pollution so that they can take appropriate measures.
- To meet the requirements of European Directives on Air Pollution by ozone, sulphur dioxide and nitrogen dioxide.
- To provide Government with up-to-date scientific and policy advice.

A Brief History

- First UK daily air quality forecasts were issued in October 1990.
- Forecasts based on;
 - Current Air Pollution.
 - Weather Summaries.
 - Human Judgement.
- Disseminated by:
 - MODEM file transfer to Met Office dot-matrix printer.
 - BBC Weather Presenters.



BBC Weatherman



The Current System

- 24-hour forecasts are compiled by netcen and the Met Office with the aid of forecasting models.
- Disseminated twice-daily to Teletext, Free-Phone and a Web Site.
- A national "Media Bulletin" is issued by e-mail at 5 p.m. daily.
- Long-range pollution outlooks are prepared and distributed by e-mail to Government Departments on Tuesdays and Fridays.

Health Effects Based Reporting

- UK based health effects expert groups have assessed the likely impact of ambient pollutant concentrations on the public.
- A 1-10 index scale has been set for each of five pollutants based on these studies.
- Air Pollution Bulletins and Forecasts report the index for **worst** pollutant in each region of the UK.



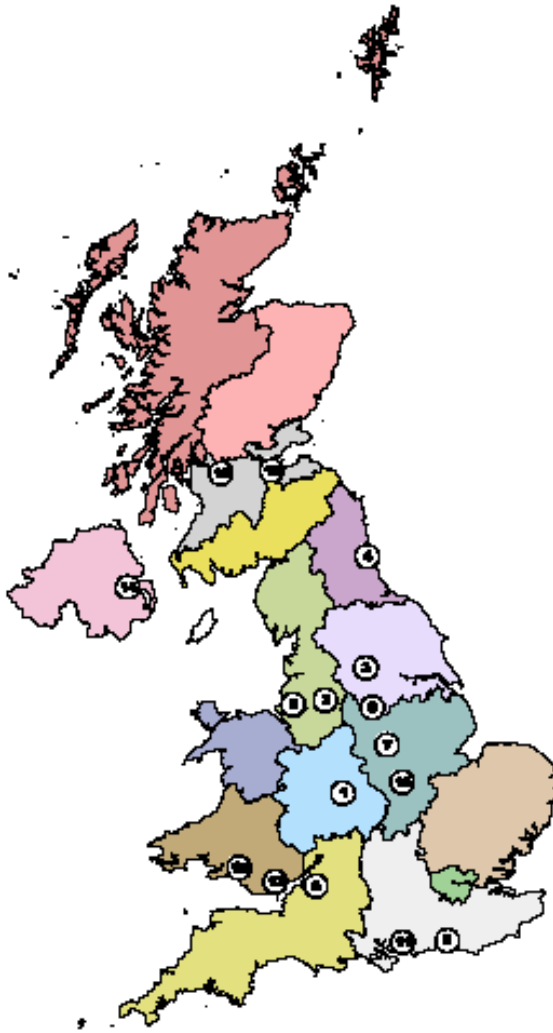
The Air Pollution Index

Index	SO ₂	NO ₂	O ₃	PM ₁₀	CO	
						15 min
Very High	10	> 400	> 400	>180*	>100	>20
High	7 – 9	200 – 399	300 – 399	90 – 179	75 – 99	15 – 19.9
Moderate	4 – 6	199 – 100	150 – 299	50 – 89	50 – 74	10 – 14.9
Low	1 – 3	< 100	<150	<50	<50	<10

ppb, $\mu\text{g m}^{-3}$ or ppm(CO)

COMEAP

Zones and Agglomerations



- For compliance with EC Directives the UK has been split into 16 zones and 28 agglomerations.
- Forecasts are issued for rural, urban background and roadside locations in each zone and 16 agglomerations.

List of Agglomerations

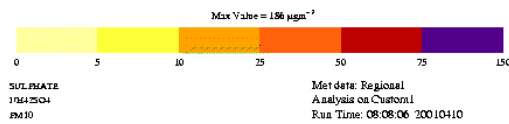
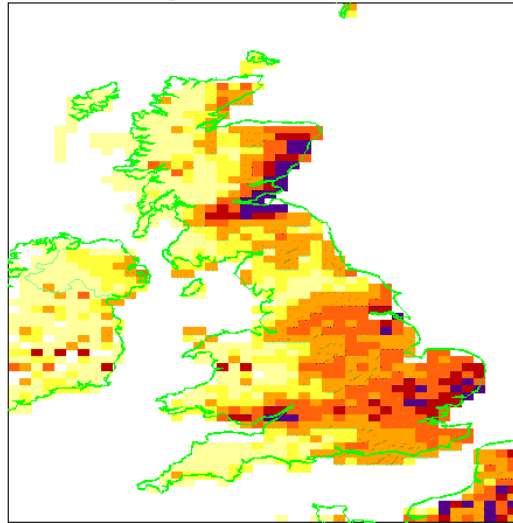
Agglomeration	Population
Greater London	7650944
West Midlands Urban Area	2296180
Greater Manchester Urban Area	2277330
West Yorkshire Urban Area	1445981
Tyneside	885981
Liverpool Urban Area	837998
Sheffield Urban Area	633362
Nottingham Urban Area	613726
Bristol Urban Area	522784
Brighton/Worthing/Littlehampton	437592
Leicester	416601
Portsmouth	409341
Swansea/Neath/Port Talbot	272456
Cardiff	306904
Edinburgh Urban Area	416232
Glasgow Urban Area	1315544
Belfast	475987

How do we Compile the Forecast?

Met Office : NAME MODEL

Valid at 0100UTC/10/04/2001 (T+ 1H)

1hr Averaged PM10 0-80m Air Concentration



- The Met Office NAME model.

- The Ozone Trajectory model.

FORECAST OZONE CONCENTRATIONS (PPB)
AND ASSOCIATED BACK TRAJECTORIES

18/06/2000 1200

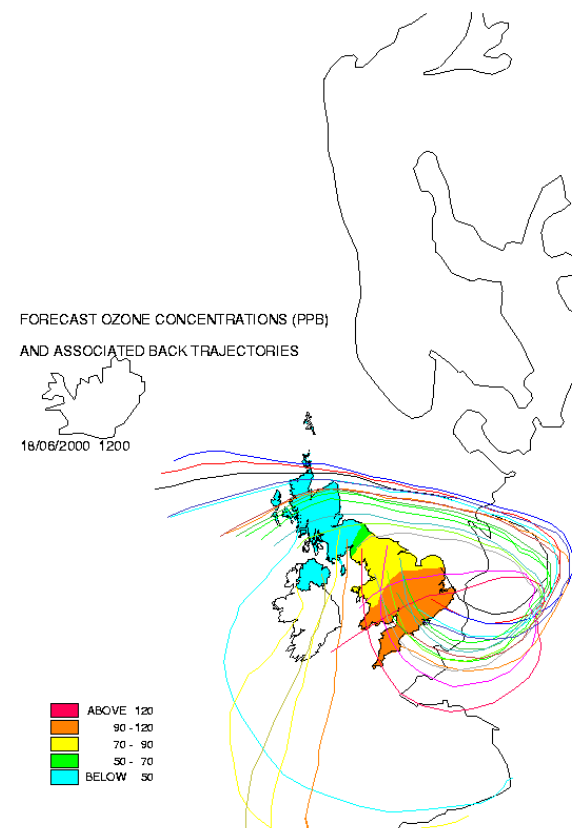
ABOVE 120
90 - 120
70 - 90
50 - 70
BELOW 50

Ozone Modelling

- Ozone formation is complicated:
 - Complex models can include over 100 emitted VOCs, 10,000 reactions, and 3,500 species.
 - But these models can take several days to run.
- Results from complex models used to develop a forecasting model:
 - Ozone formation in the UK is typically 'VOC limited'.
 - Identify the top 20 VOCs contributing to ozone.
 - Rate determining step is OH attack on VOC.
 - Estimate the number of ozone molecules per VOC.

The Ozone Trajectory Model

- Simplified chemistry along a forecast 96 hour trajectory:
 - since 1992.
 - with updates to the VOC emissions inventories and chemical scheme.
- Peak hourly concentration predicted at 20 sites for 1, 2 and 3 days ahead.
- Used to produce an interpolated map:
 - UK coverage
 - “Rural” Prediction.



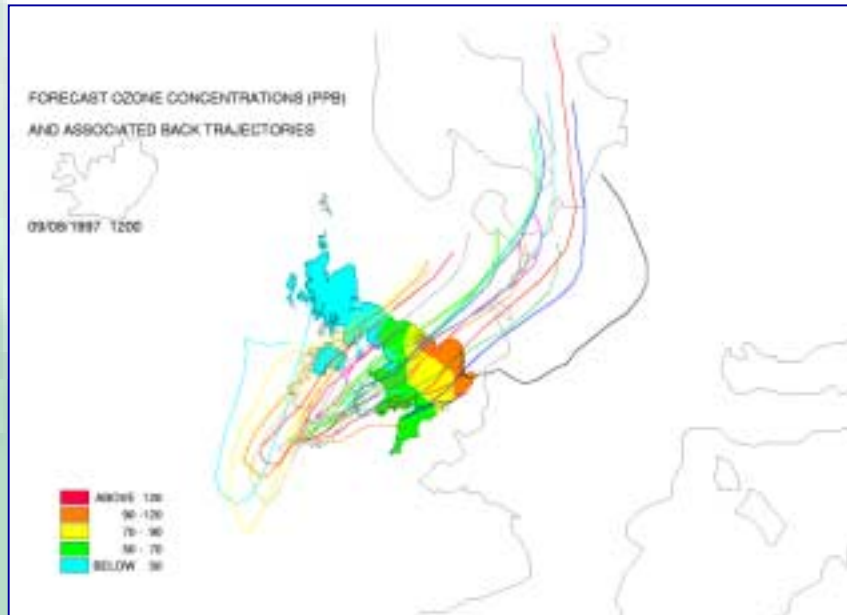
Ozone Forecast Success Rate and Accuracy

- Typically 80% of "HIGH" episodes (Index 7 or greater) are "successfully" forecast. This means that a measured episode was correctly forecast.
- A cautious approach to protecting public health has been adopted. This results in a degree of over-prediction.
- Typically 40-50% of "HIGH" episodes are "accurately" forecast. This measure takes account of episodes which were forecast but did not occur.

Origins of Episodes

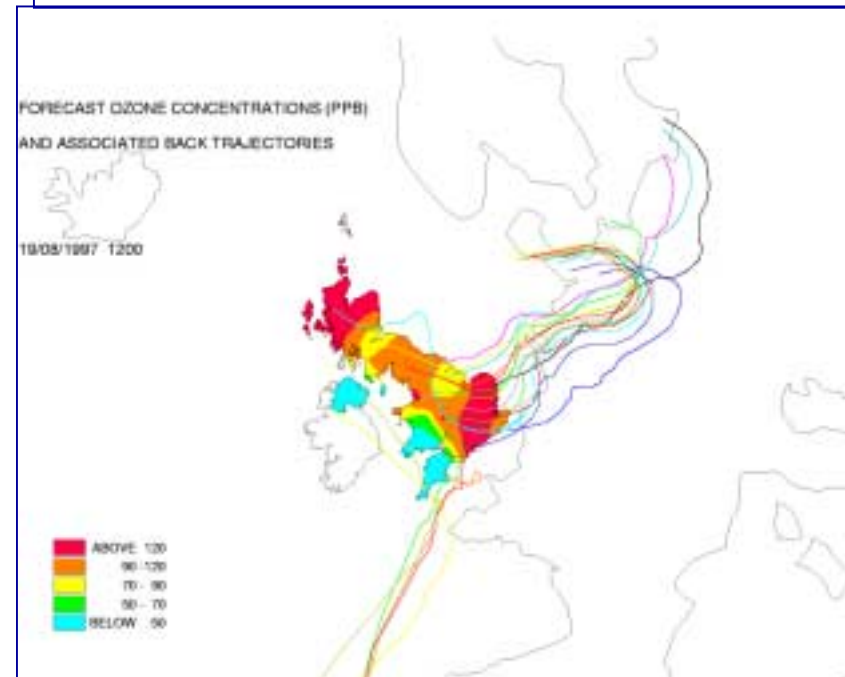
- The ozone trajectory model can be run to estimate the relative contributions of UK and European emissions to an air pollution episode.
- This is very important from a policy perspective, putting the episode into a wider European context.
- Most ozone episodes result from:
 - Hot sunny weather.
 - Light winds.
 - Often with transport of air masses from the east.

Different Episode Types



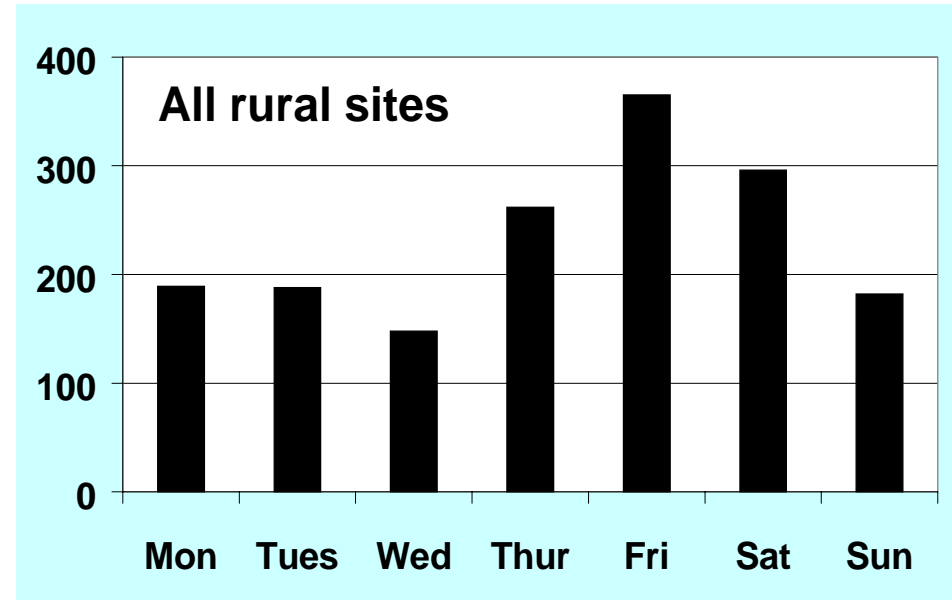
	UK + Ireland	Europe
9 August 1997	80	20

	UK + Ireland	Europe
19 August 1997	25	75



Other Factors

- Day-of-the-week.
 - Reduced emissions at weekends.
 - More episodes on Fridays.
- Urban NO_x scavenging.
 - Cities are more “rural” at weekends.
- Cloud Cover.
 - Model assumed clear skies.
 - Therefore overestimated ozone concentrations when it was cloudy.
 - Cloud cover along the trajectory path is now included.



The Met Office NAME Model

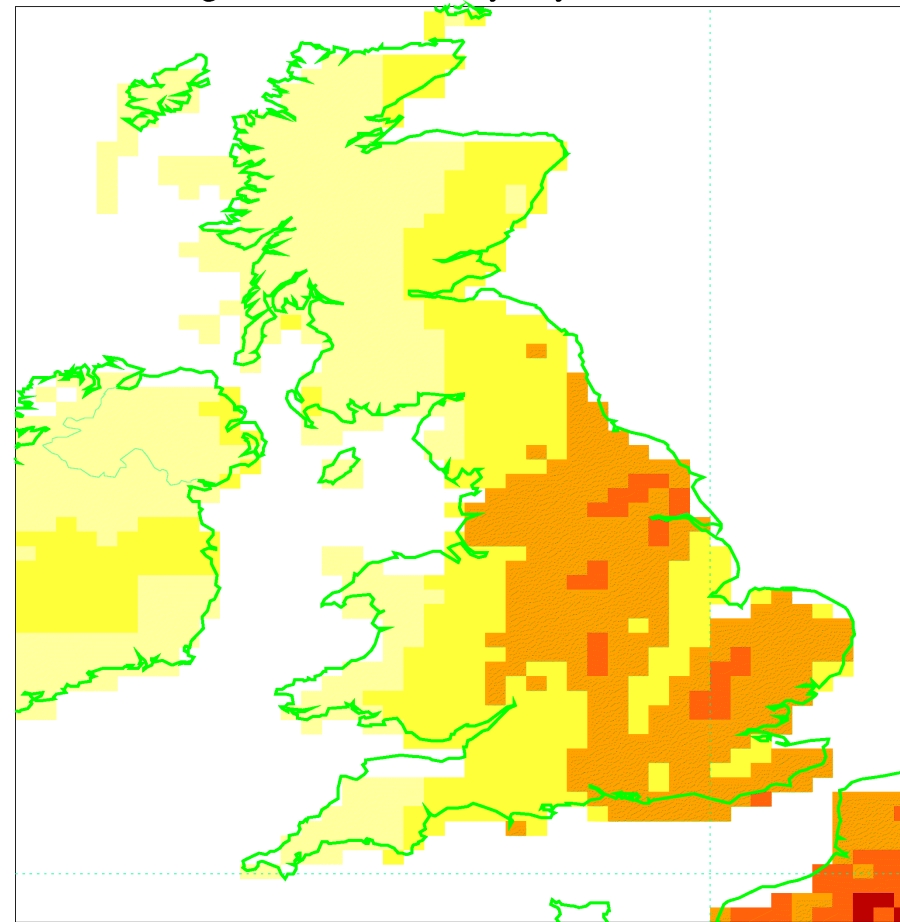
- A sophisticated Lagrangian particle Dispersion Model owned by the Met Office.
- Uses UK and EMEP emissions inventories.
- Predicts background NO_x , NO_2 , CO, SO_2 and PM_{10} (including secondary).
- Uses 3-D meteorology.
- Output is on a UK-grid of ~ 11km squares.

The Met. Office : NAME MODEL

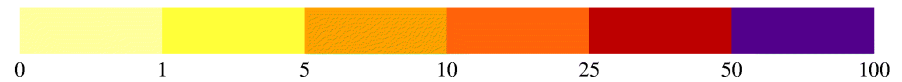
Valid at 1200UTC/14/02/2000 (T+000H)

3hr Averaged PM10 Boundary Layer Air Concentration

Example of Graphical Output



Max Value = 29 $\mu\text{g m}^{-3}$



Primary UK Traffic
Primary UK Industry
Secondary SULPHATE
Secondary AMMONIUM SULPHATE
Primary EUROPE

Met data: Regional
Analysis on Custom1
Run Time: 20:31:51 15-Feb-00

Weather Forecasts

- All the models take forecast meteorological parameters from the Met Office.
- The accuracy of these forecasts is crucial to model performance.
 - Is the situation stable or changing rapidly?
 - Will weather fronts arrive before or after peak traffic emissions periods?

Expert Judgement

- netcen has a team of five duty forecasters.
- All are involved in the UK's air quality monitoring programmes with a wealth of knowledge in atmospheric physics and chemistry.
- Expert judgement means assessing the accuracy of model outputs, weather forecasts and measurement data on any given day.
- Also adding information on "unusual" sources of pollution.

“Unusual” Episodes - Mainly PM₁₀

- Local construction activity, agriculture etc.
- Bonfire Night.
- Saharan Dust Storms.
- Russian Forest Fires.



PM₁₀ Forecast Success Rate and Accuracy

- Typically 35% of “HIGH” episodes (Index 7 or greater) are “successfully” forecast. 25% are “accurately” forecast.
- Best where motor vehicle or area sources (e.g. Belfast) are dominant in an episode.
- Recent difficulties:
- Glasgow Taxis.
- Thurrock Industry.
- Cardiff construction.



Forecast Dissemination Free-Phone

- 0800 556677
- Callers are directed initially to their local region.
- Bulletins and forecasts updated hourly, pollution alerts, health effects information, brochure request.



RTWOLUTION

GREATER
LONDON

11am Fri Apr 5th

FORECAST FOR GREATER LONDON

to 10am Sat Apr 6th

In London near busier roads
levels will be 4 (MODERATE)

Elsewhere in London
levels will be 4 (MODERATE)

Check out the Green Scene 130 C4

TELETEXT-NEW IMPROVED DATING! p390

Air Pollution Forecasts On the World-Wide Web

Air Pollution Forecasting in the UK

[UK Forecasting home](#) | [Forecasting Reports](#) | [Data and Statistics](#) | [Frequently Asked Questions](#)
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Welcome to UK Air Pollution Forecasting!

These pages provide information from DEFRA and the devolved administrations. Here you will find daily updated forecasts for up to 24-hours ahead of UK air pollution concentrations. Forecasts are issued for sixteen urban areas and sixteen UK regions for roadside, urban background and rural locations. If an Air Pollution Episode Alert is issued then further details will be published here.

Click on the Map for the Latest Regional Air Pollution Forecast

Air Pollution Episode Alert
Date : 24-02-03

There are no Air Pollution Episode Alerts at present

Details of Air Pollution Episode Alerts will appear here as and when they are issued.

- [The Air Pollution Forecast for all Regions](#)
- [What the Forecast Means](#)
- [How the Forecast is Made](#)

Select an Area of Interest

www.airquality.co.uk

Air Pollution Forecast
Issued at 16:00 on 25/06/2002
This forecast is valid until 16:00 on 26/06/2002

Zone	In rural areas	In towns and cities away from busier roads	In towns and cities next to busier roads
Central Scotland	3 (Low)	3 (Low)	2 (Low)
East Midlands	3 (Low)	3 (Low)	2 (Low)
Eastern	3 (Low)	3 (Low)	2 (Low)
Greater London	n/a	3 (Low)	2 (Low)
Highland	3 (Low)	3 (Low)	2 (Low)
North East	3 (Low)	3 (Low)	3 (Low)
North East Scotland	3 (Low)	3 (Low)	2 (Low)
North Wales	3 (Low)	3 (Low)	2 (Low)
North West & Merseyside	3 (Low)	3 (Low)	3 (Low)
Northern Ireland	3 (Low)	3 (Low)	2 (Low)
Scottish Borders	3 (Low)	3 (Low)	1 (Low)
South East	3 (Low)	3 (Low)	2 (Low)
South Wales	3 (Low)	3 (Low)	3 (Low)
South West	3 (Low)	3 (Low)	2 (Low)
West Midlands	3 (Low)	3 (Low)	3 (Low)
Yorkshire & Humberside	3 (Low)	3 (Low)	2 (Low)

Forecast Dissemination E-mail Bulletins

- Free Email service currently received by 150 + organisations including;
 - Weather Centres.
 - TV and Newspapers.
 - Government, Researchers.
- Issued daily at 5pm
 - Summary of previous 24-hours' air quality.
 - Forecast for the next 24-hours.
 - Detailed, region-by-region information.

CEEFAX and BBC Online - 5 Day Forecast

BBC i CATEGORIES TV RADIO COMMUNICATE WHERE I LIVE INDEX SEARCH

MONDAY
24th February 2003
[Text only](#)

BBC Weather

[BBC Homepage](#) **Wantage, Oxfordshire**

	Monday	Tuesday	Wednesday	Thursday	Friday
5-Day Forecast					
Temperature (°C / °F)	Max: 11/51 Min: 5/41	Max: 8/46 Min: 4/39	Max: 10/50 Min: 3/37	Max: 11/51 Min: 8/46	Max: 12/53 Min: 5/41
Air Pollution Index	3	3	3	3	3
Sun Index	1	1	1	1	1
Wind Speed (mph)	10 SE	13 SE	13 SE	12 S	5 SW
Sunrise (GMT)	7:04	7:02	7:00	6:57	6:55
Sunset (GMT)	17:33	17:35	17:37	17:39	17:41

Current Nearest Observations

Temperature (°C / °F)	12 / 53
Relative Humidity	66 %
Wind Speed (mph)	10 (E)
Pressure (mB)	1020, Falling
Visibility	Good

Nearest weather station located at Lat: 51.580 , Long: -1.430. (14 km). Observed at 1500 24/2/2003.

- Set Wantage to be my hometown [Why?](#)
- Go to the [BBC Weather Centre](#).
- [Go to Europe Continental Weather](#)
- Go to [South East Regional Weather](#)

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Consistency of Forecasts

- Both defra and the BBC use the 1-10 Air Pollution Index approved by COMEAP:
 - 1-3 (LOW)
 - 4-6 (MODERATE)
 - 7-9 (HIGH)
 - 10 (VERY HIGH)
- Netcen and the Met Office apply a quality control system to ensure that the regional defra forecasts agree with the values for the BBC's 230 towns and cities.

Summary

- Air Pollution Forecasts are compiled using modelling and expert judgement.
- They are widely disseminated in the UK.
- They meet statutory requirements and inform the public.
- Large numbers of people access the information.
- The dissemination services and forecast accuracy are constantly being reviewed and improved.