

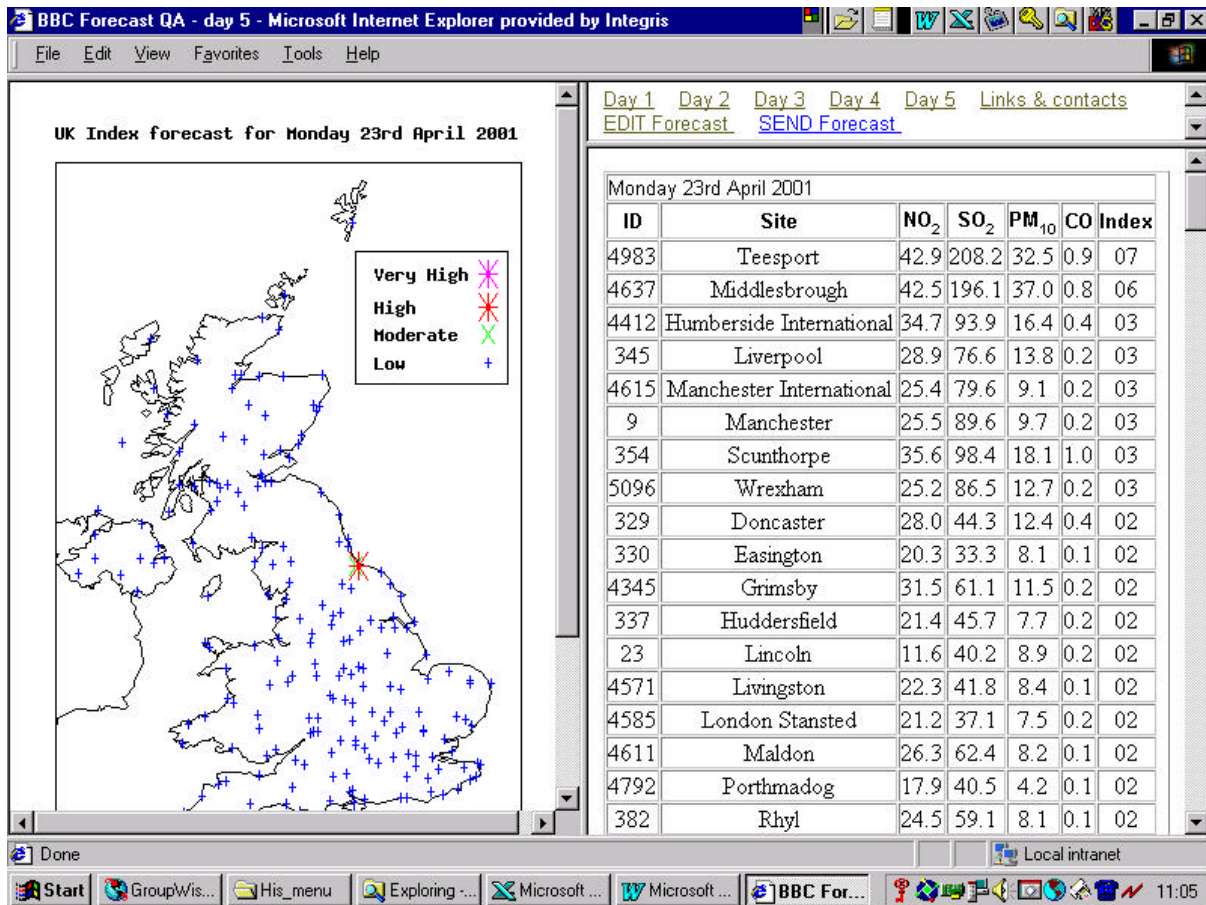
ANALYSIS OF AIR POLLUTION FORECASTING SUCCESS RATE, JANUARY TO MARCH 2001

Background

A forecast of the following day's air pollution is prepared every day by NETCEN. The forecast consists of a prediction of the air pollution band for the worst-case situation in each region over the following 24-hours. Forecasts can be updated and disseminated through TELETEXT, the World Wide Web and FREEPHONE telephone number at any time of day, but the most important forecast of the day is the "daily media forecast". This is prepared at 3 p.m. for sending to the DDU before 4pm each day, and is then included in subsequent air quality bulletins for the BBC, newspapers and many other interested organisations. This report covers the media forecasts issued during the three months from 1 January 2001 to 31 March 2001. Results from forecasting models were available each day and were used in constructing the forecast. The forecasters issue predictions for rural, urban background and roadside environments, but for the purposes of this report these have been combined into a single "worst-case" category.

Twice per week, on Fridays and Tuesdays, we also provide a long-range pollution outlook. This takes the form of a short piece of text which is e-mailed to around twenty recipients in the DETR and other government Departments, plus the BBC weather forecasters. The outlook is compiled by looking at the output from our pollution models, which currently run out to 3 days ahead for DETR, and by assessing the long-term weather situation.

During the first quarter of 2001 we also implemented a quality control system to ensure that the 5-day forecasts provided by the Met. Office to the BBC were consistent with the "daily media forecasts" and long-range pollution outlook provided by NETCEN for the DETR. The BBC required 5-day air pollution index forecasts for 230 UK towns and cities on their BBC Online service. Given the large amount of data involved we decided to develop an interactive Web based system to enable the predictions to be Quality Controlled by the NETCEN forecasters. The figure overleaf shows an example of how the Web based system looks.



The daily maximum pollution index prediction is plotted on a colour coded map, whilst the data for the 230 towns and cities are also sorted in a table so that the highest pollution index predictions appear at the top. The pollution index is broken down into the component pollutants so that the forecasters can see which species are triggering any 'High' predictions. If the forecasts do not agree with the DETR predictions then the NETCEN forecasters are able to adjust the predicted index values and send the corrected data back to the Met. Office for submission to the BBC. The quality control work is carried out at around 3 p.m. daily with the forecast updating onto the BBC Online Web site at 4 a.m. the following morning.

Analysis of Forecasting Success Rate

The forecasting success rates for carbon monoxide, particles, ozone, nitrogen dioxide and sulphur dioxide are presented in the tables below. The tables give the number of HIGH days measured; the number of HIGH days forecast; the number of days with a correct forecast of HIGH air pollution; the number of days when HIGH air pollution was forecast but not measured on the following day and the number of days when HIGH air pollution was measured but had not been forecast.

Forecast Analysis for CO, 1 January 2001 to 31 March 2001.

There were no instances of 'High' air pollution forecast or measured for carbon monoxide in any region during this period.

Forecast Analysis for PM₁₀, 1 January 2001 to 31 March 2001.

Forecast Analysis for England, PM₁₀, 1 January 2001 to 31 March 2001.

	NW England	NE England	Midlands	East Anglia	SW England	SE England	London
HIGH days measured	2	4	2	0	1	0	4
HIGH days forecast	1	1	4	0	1	1	4
OK: fore & meas.	0	0	2	0	0	0	2
WRONG: fore & not meas.	1	1	2	0	1	1	2
WRONG: not fore & meas.	2	4	0	0	1	0	2

Forecast Analysis for Scotland, Wales and Northern Ireland, PM₁₀, 1 January 2001 to 31 March 2001.

	N Ireland	Scotland	Wales	Total (UK)
HIGH days measured	1	5	0	19
HIGH days forecast	4	4	0	20
OK: fore & meas.	1	0	0	4
WRONG: fore & not meas.	3*	4	0	16
WRONG: not fore & meas.	1	5	0	15

* These forecasts were correct if Belfast Clara Street data are included. This site was still on the air quality bulletins during this period.

Forecasts of 'High' air pollution for PM₁₀ were issued for many regions of the UK over the period January 18th to 22nd.

In Northern Ireland the forecast for the 18th was correct, whilst on the other days 'Very High' PM₁₀ was recorded at the Belfast Clara St. monitoring site. As discussed in the previous report the data from this monitor should be treated with caution as it uses a different methodology and may over-read by 30%.

In Scotland 'High' PM₁₀ air pollution was recorded at the Glasgow Kerbside site on January 18th, although only 'Moderate' was forecast for this day. On three subsequent days 'High' levels were forecast but only 'Moderate' was measured. There was a separate period of 'High' concentrations from February 28th to March 7th which was not forecast. These were very localised concentrations - the local site operator reported that taxis were parked next to the monitoring site with their engines idling

In NW England a 'High' forecast was issued on January 18th, but only 'Moderate levels (68 µgm⁻³) were reported at Liverpool. 'High' concentrations were recorded at Bury Roadside on March 5th and 6th when 'Low' levels were forecast, the results appear genuine so could have been caused by excessive congestion on the M62 during a period of poor atmospheric dispersion.

In NE England a 'High' forecast was also issued on January 18th, but only 'Moderate levels were reported. 'High' concentrations were recorded at Leeds on February 15th and 16th when 'Moderate' levels were forecast and also at Scunthorpe on March 6th and 7th when 'Moderate' was again forecast. Both the Leeds and Scunthorpe sites are influenced by industrial emissions, although PM₁₀ levels were also generally elevated due to poor dispersion conditions at these times.

In the Midlands two out of four 'High' forecasts issued between January 18th and January 22nd were correct (measured 'High' at Nottingham). 'Moderate' levels were reported on the other days.

In SW England 'High' PM₁₀ was forecast on January 18th but not reported until January 20th at Bristol i.e. a day later than predicted.

In London 'High' forecasts were issued on four days between January 18th and January 22nd, but only recorded as predicted on two days – January 19th and 20th. 'High' concentrations were also recorded at London Marylebone Road on February 15th (76 µgm⁻³) and 16th (79 µgm⁻³) when 'Moderate' levels were forecast. Concentrations were only very slightly higher than expected on these two days.

PM₁₀ episodes are extremely difficult to forecast as they require accurate predictions of the primary, secondary and coarse fractions of the pollutant. The January episode reported here had a relatively large secondary contribution at the beginning, on January 18th, as rural monitoring locations were recording over 30 µgm⁻³ of PM₁₀. This was around 10 µgm⁻³ higher than the model predicted for the areas where 'High' pollution was measured on the first day of the episode. Subsequently the measured secondary PM₁₀ (i.e. rural sites) fell to around 15-20 µgm⁻³, whereas the modelled concentrations were then higher in some areas causing us to over-predict concentrations. This is most likely to be due to differences between the forecast and measured trajectories upon which the secondary PM₁₀ predictions are based.

In most cases the measured regional maximum concentrations during this episode were between 60 and 70 μgm^{-3} , with just odd sites affected by exceptional local factors reaching the 'High' pollution threshold. Where we had near misses we were therefore out by around 7-20%. Most of the near-misses were over-predictions which we would consider to be expected by taking a cautious approach. An approach which tends to over-predict episodes slightly should enable the public to take precautions over their health, and possibly alter their behaviour to reduce pollutant emissions. If we under-predict on average then unexpected high pollutant levels may adversely affect peoples' health.

Forecast Analysis for Ozone, 1 January 2001 to 31 March 2001.

A number of instances of 'High' air pollution for ozone were reported at the Ladybower monitoring site in NE England during this period. However, these were related to an analyser malfunction and the data will be removed from the archive during ratification. For the purposes of the forecast analysis we have ignored these results, so there were no instances of 'High' air pollution forecast or measured for ozone in any region during this period.

Forecast Analysis for Nitrogen Dioxide, 1 January 2001 to 31 March 2001.

There were no instances of 'High' air pollution forecast or measured for Nitrogen Dioxide in any region during this period.

Forecast Analysis for Sulphur Dioxide, 1 January 2001 to 31 March 2001.Forecast Analysis for England, Sulphur Dioxide, 1 January 2001 to 31 March 2001.

	NW England	NE England	Midlands	East Anglia	SW England	SE England	London
HIGH days measured	0	0	0	0	0	0	0
HIGH days forecast	0	0	0	0	0	0	0
OK: fore & meas.	0	0	0	0	0	0	0
WRONG: fore & not meas.	0	0	0	0	0	0	0
WRONG: not fore & meas.	0	0	0	0	0	0	0

Forecast Analysis for Scotland, Wales and Northern Ireland, Sulphur Dioxide, 1 January 2001 to 31 March 2001.

	N Ireland	Scotland	Wales	Total (UK)
HIGH days measured	0	0	0	0
HIGH days forecast	4	0	0	4
OK: fore & meas.	0	0	0	0
WRONG: fore & not meas.	4	0	0	4
WRONG: not fore & meas.	0	0	0	0

Forecasts of 'High' air pollution for SO₂ were issued for Northern Ireland on January 18th, 19th, 20th and 22nd. Over this period measured concentrations remained within the 'Moderate' air pollution band with a maximum 15-minute mean SO₂ concentration of 168 ppb being recorded at the Belfast East monitoring station. The 'High' band is not breached until the 15-minute mean exceeds 400 ppb; the over-predictions are likely to have been due to:

- The atmospheric inversion conditions not being as severe as expected. i.e. Temperatures not reaching the minimum predicted, and/or more turbulence in the lower atmosphere than expected.
- SO₂ emissions in Belfast having dropped significantly below the levels currently in the emissions inventory used for modelling.
- A combination of both of the above.

The third option is the most likely. Minimum temperatures for the period were only slightly higher than expected (1 or 2 degrees), and whilst there was little or no wind reported it only requires a slight westerly breeze to clear the air over Belfast significantly. We also know that SO₂ emissions in Belfast have fallen dramatically over recent years, and that the current inventory is

two years out of date. Expert judgement or a correction factor need to be applied to account for the changes in emissions. The use of expert judgement is the most flexible, as forecasters are able to “learn” in real-time from the latest measurements during air pollution episodes. The calculation of correction factors can only be based on an average over a significant time period, and is therefore still likely to produce results which are out of date when the situation is continuously changing.

There were no instances of ‘High’ air pollution forecast or measured for Sulphur Dioxide in any other region during this period.