UK Air Quality Forecasting: Operational Report for April to June 2008

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

AEAT/ENV/R/2663 Issue 1, July 2008

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Title	UK Air Quality Forecasting: Operational Report for April to June 2008.
Customer	Department for Environment Food and Rural Affairs, the Scottish Executive, the Welsh Assembly Government and the Department of the Environment in Northern Ireland
Customer reference	EPG 1/3/179
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File reference	ED45099
Report number	AEAT/ENV/R/2663 Issue 1
Report status	Finalised

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AEA Energy & Environment is an operating division of AEA Technology plc
AEA Technology is certificated to BS EN ISO9001:(1994)

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Executive Summary

This report covers the operational activities carried out by AEA Energy & Environment and the Met Office under the UK Air Quality Forecasting Contract from April to June 2008. The work is funded by the Department for Environment Food and Rural Affairs (Defra), the Scottish Executive, Welsh Assembly Government and the Department of the Environment in Northern Ireland.

During the second quarter of 2008, there were four days on which HIGH or above air pollution were recorded. One HIGH day was due to PM_{10} and is thought to have been the result of traffic related pollution. The remaining 3 HIGH days were due to ozone during warm weather and easterly air trajectories.

Overall forecast success and accuracy rates for the HIGH band were around 220 % and 40 % respectively as an average for zones and agglomerations during this quarter. The success rate was very high (above 200%) mainly as a result of good quality forecast model run results and forecasts issued during the ozone episode in early May. Please note success rates above 100 % are possible, as detailed in section 3 of this report.

Many MODERATE days were measured (mainly for ozone but included a fair contribution from PM_{10}) and were forecasted with a high degree of success in both zones and agglomerations and a reasonable average accuracy figure of around 85 %. These MODERATE periods are recorded within the forecasting success and accuracy calculations. The forecasting success and accuracy for this quarter for HIGH and MODERATE episodes is summarised in Table 1 below.

Success figures for MODERATE forecasts issued show that a significant proportion of measured polluted days were successfully forecast (percentage above 100 %). An average accuracy figure of approximately 85 % is likely to indicate that 15 % of the forecast MODERATE levels were not measured and remained LOW. The accuracy figures often tend to be lower due to the precautionary approach that AEA Energy & Environment takes when issuing the daily forecasts- we intentionally issue a forecast for MODERATE pollution when there is only a small chance that it will be recorded.

Table 1 – Forecast success/accuracy for incidents above 'HIGH' and above 'MODERATE', April 1st to June 30th 2008.

Region/Area	HIGH		MODERATE	
	% success	% accuracy	% success	% accuracy
Zones	200	57	112	89
Agglomerations	233	33	124	83

We continue to research ways of improving the air pollution forecasting system by:

1. Investigating new approaches to using automatic software systems to streamline the activities within the forecasting process, thus allowing forecasters to spend their time more productively considering the most accurate forecasts.
2. Researching the chemistry used in our models, for example the chemical schemes for secondary PM_{10} and ozone.
3. Improving the NAME model used for ad-hoc analyses. In particular, recent improvements have assisted with investigations of the possible long-range transport of PM_{10} pollution from forest fires in Russia and the long-range transport of particles from Saharan Dust Storms.
4. Improving and updating the emissions inventories used in our models.

There were no reported breakdowns in the forecasting service between April and June; all bulletins were successfully delivered to the Air Quality Communications contractor on time.

Contents

1 Introduction

In collaboration with the Met Office, a forecast of the following day's air pollution is prepared every day by AEA Energy & Environment. The forecast consists of a prediction of the air pollution descriptor for the worst-case situation in 16 zones and 16 agglomerations over the following 24-hours. Forecasts can be updated and disseminated through Teletext, the World Wide Web and a 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 3.00 p.m. for uploading to the Internet and Air Quality Communications contractor before 4.00 p.m. each day, and is then included in subsequent air quality bulletins for the BBC, newspapers and many other interested organisations.

This report analyses and reviews the media forecasts issued during the second quarter of 2008. Results from forecasting models are available each day and are used in constructing these forecasts. 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 every week, on Tuesdays and Fridays, we also provide a long-range pollution outlook. This takes the form of a short text message; this is emailed to approximately sixty recipients in Defra and other Government Departments, together with the BBC weather forecasters. The outlook is compiled by careful assessment and review of the outputs from our pollution models- which currently cover up to 3 days ahead- and by also considering the long-term weather situation.

We continue to provide a comprehensive quality control system to ensure that the 5-day forecasts provided by the Met Office to the BBC are consistent with the "daily media forecasts" and long-range pollution outlook provided by AEA Energy & Environment for Defra and the Devolved Administrations. The BBC requires 5-day air pollution index forecasts for 337 UK towns and cities on their BBC Online service. The quality control checks are carried out at around 3.00 p.m. daily, with the forecast updating onto the BBC Online Web site at 4.00 a.m. the following morning.

The National forecasts are also quality controlled for consistency with forecasts issued by AEA for BSkyB, UK regions and individual local authorities.

2 New developments during this period

2.1 MET OFFICE DEVELOPMENTS

On the 18th April 2008 the Met Office responded to a phone call from Defra regarding a strange smell in the south-east of England. Back-trajectories and meteorological data together with AURN observations were used to provide an initial interpretation that the smell had come from a European agricultural source and liaison with the AEA duty forecaster led to the quick release of a short report to this effect. During the day the Met Office Press Office responded to many media and public enquiries about the event. In the following weeks, ammonia and ammonium data from Auchencorth Moss (kindly provided by CEH) were analysed and further enquiries into the source were made in collaboration with the HPA.

During April and May the Met Office had been liasing with SEPA regarding the shut-down and start-up of the Grangemouth oil refinery due to strike action. The Met Office was quick to respond to concerns that dust noticed on 4 May in eastern Scotland came from the refinery and was able to provide evidence that the event was caused by Saharan dust and had been noticed over much of the UK. This was a complicated Saharan dust case and it is thought that frontal rainfall activity caused the dust to be washed out from height over the UK.

The Met Office sent a number of attendees to the National Air Quality Forecasting Seminar on the 14th May 2008 and Claire Witham gave a talk about the influence of long-range transport in recent UK air pollution events, highlighting the techniques that are used under this contract to interpret such events. Claire also gave an invited talk at the 11th June 2008 IAPSC meeting on the Met Office's role in responding to air quality incidents.

During this quarter considerable development of the air quality system has also been carried out so that it will be based around NAMEIII and use the Met Office's latest error checking and reporting system.

2.2 AEA ENERGY & ENVIRONMENT DEVELOPMENTS

In late April the AEA forecasting team worked in collaboration with the Met Office to identify the source of the odour reported in parts of England on the 18th April. Two runs of the NAME model confirmed that the air reaching the parts of England reporting the odour had passed over Germany, the air that had reached unaffected Scotland had passed over the sea, to north of Denmark.

The AEA forecasting team also investigated a series of unexpected PM_{10} pollution spikes on Sunday 25th May, measured at some sites in North East England. Only Middlesborough and the industrial Scunthorpe Town measured a MODERATE band exceedence on that day, however, a short term episode was also measured at Leeds, Sheffield and York and peaked at midday on the 25th. No obvious source of the pollution could be identified from air mass back-trajectory plots or satellite imagery, however the BBC news website reported moorland fires in Yorkshire over that bank holiday weekend which could have possibly been the cause.

AEA continued to work in collaboration with the Met Office on near-future developments.

3 Analysis of Forecasting Success Rate

Analysis of the forecasting performance is carried out for each of the 16 zones and 16 agglomerations used in the daily forecasting service. Further details of these zones and agglomerations are presented in Appendix 2. Forecasting performance is analysed for a single, general pollutant category rather than for each individual pollutant and has been aligned to the forecasting day (a forecasting day runs from the issue time, generally 3 pm). This analysis of forecasting performance is based on provisional data, as used in the daily forecasting process. Any obviously faulty data have been removed.

The analysis treats situations where the forecast index was within ±1 of the measured index as a successful prediction, as this is the target accuracy we aim to obtain in the forecast. Because the calculations of accuracy and success rates are based on a success being ±1 of the measured index, it is possible to record rates in excess of 100% rather than 'true' percentages. Appendix 3 shows a worked example of how accuracy and success rates are calculated. Further details of the text descriptions and index code used for the forecasting are given in Appendix 1.

The forecasting success rates for each zone and agglomeration for the quarter reported on are presented in Tables 3.1 (forecasting performance in zones) and 3.2 (forecasting performance in agglomerations) for 'HIGH' days. Table 3.5 provides a summary for each pollutant of the number of days on which HIGH and above pollution was measured, the maximum exceedence concentration and the day and site at which it was recorded. The forecasting performance Tables 3.1 and 3.2 give:

- The number of 'HIGH' days measured in the PROVISIONAL data
- The number of 'HIGH' days forecast
- The number of days with a correct forecast of 'HIGH' air pollution, within an agreement of ±1 index value. A HIGH forecast is recorded as correct if air pollution is measured HIGH and the forecast is within ±1 index value, or it is forecast HIGH and the measurement is within ±1 index value. For example measured index 7 with forecast index 6 counts as correct, as does measured index 6 with forecast index 7.
- The number of days when 'HIGH' air pollution was forecast ('f' in the tables) but not measured ('m') on the following day to within an agreement of 1 index value.
- The number of days when 'HIGH' air pollution was measured ('m') but had not been forecast ('f') to within an agreement of 1 index value.

The two measures of forecasting performance used in this report are the 'success rate' and the 'forecasting accuracy'.

The forecast success rate (%) is calculated as:

- (Number of episodes successfully forecast/total number of episodes measured) x 100

The forecast accuracy (%) is calculated as:

- (Number of episodes successfully forecast/[Number of successful forecasts + number of wrong forecasts]) x 100

The forecasting success rates for 'MODERATE' days or above for each zone and agglomeration are presented in Tables 3.3 (zones) and 3.4 (agglomerations). Table 3.3 and 3.4 give the same information as in Tables 3.1 and 3.2, but summarised for 'MODERATE' days and above.

3.1 FORECAST ANALYSIS FOR APRIL 1ST TO JUNE 30TH 2008.

Table 3.1 - Forecast Analysis for UK Zones 'HIGH' band and above *

ZONES	Central Scotland	East Mids	Eastern	Greater London	Highland	North East	North East Scotland	North Wales	North West & Merseyside	Northern Ireland	Scottish Borders	South East	South Wales	South West	West Midlands	Yorkshire & Humberside	Overall
measured days	0	3	0	0	0	0	0	0	1	0	0	0	1	3	0	2	10
forecasted days	0	4	3	4	0	2	0	1	3	0	1	4	3	3	3	4	35
ok (f and m)	0	3	2	2	0	0	0	1	2	0	0	0	2	2	2	4	20
wrong (f not m)	0	1	1	2	0	2	0	0	1	0	1	4	1	1	1	0	15
wrong (m not f)	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
success %	N/c	100	N/c	N/c	N/c	N/c	N/c	N/c	200	N/c	N/c	N/c	200	67	N/c	200	200
accuracy %	0	75	67	50	0	0	0	100	67	0	0	0	67	40	67	100	57

Table 3.2 - Forecast Analysis for UK Agglomerations 'HIGH' band and above *

AGGLOMERATIONS	Belfast UA	Brighton/Worthing/ Littlehampton	Bristol UA	Cardiff UA	Edinburgh UA	Glasgow UA	Greater Manchester UA	Leicester UA	Liverpool UA
measured days	0	0	0	0	0	1	0	0	0
forecasted days	0	4	3	1	0	0	1	1	1
ok (f and m)	0	1	2	1	0	0	0	1	0
wrong (f not m)	0	3	1	0	0	0	1	0	1
wrong (m not f)	0	0	0	0	0	1	0	0	0
success %	N/c	N/c	N/c	N/c	N/c	0	N/c	N/c	N/c
accuracy %	0	25	67	100	0	0	0	100	0

AGGLOMERATIONS	Nottingham UA	Portsmouth UA	Sheffield UA	Swansea UA	Tyneside	West Midlands UA	West Yorkshire UA	Overall
measured days	0	0	0	0	0	2	0	3
forecasted days	1	3	0	1	0	3	0	19
ok (f and m)	0	0	0	0	0	2	0	7
wrong (f not m)	1	3	0	1	0	1	0	12
wrong (m not f)	0	0	0	0	0	1	0	2
success %	N/c	N/c	N/c	N/c	N/c	100	N/c	233
accuracy %	0	0	0	0	0	50	0	33

*** All performance statistics are based on provisional data. Obviously incorrect data due to instrumentation faults have been removed from the analyses. N/c = not calculable.**

Please refer to the start of section 3 for an explanation of the derivation of the various statistics. Figures >100 % may occur.

Table 3.3 - Forecast Analysis for UK Zones 'MODERATE' band and above *

ZONES	Central Scotland	East Mids	Eastern	Greater London	Highland	North East	North East Scotland	North Wales	North West & Merseyside	Northern Ireland	Scottish Borders	South East	South Wales	South West	West Midlands	Yorkshire & Humberside	Overall
measured days	46	62	67	59	64	24	49	49	50	25	49	48	52	55	30	74	829
forecasted days	44	61	67	53	61	31	49	45	48	28	45	54	45	51	41	60	814
ok (f and m)	53	67	73	66	67	33	56	62	65	34	50	57	56	59	44	71	929
wrong (f not m)	2	3	3	4	1	3	2	2	2	2	4	5	1	5	5	2	66
wrong (m not f)	3	3	3	2	1	4	1	2	2	0	2	4	2	3	3	6	52
success %	115	108	109	112	105	138	114	127	130	136	102	119	108	107	147	96	112
accuracy %	91	92	92	92	97	83	95	94	94	94	89	86	95	88	85	90	89

Table 3.4 - Forecast Analysis for UK Agglomerations 'MODERATE' band and above *

AGGLOMERATIONS	Belfast UA	Brighton/Worthing/ Littlehampton	Bristol UA	Cardiff UA	Edinburgh UA	Glasgow UA	Greater Manchester UA	Leicester UA	Liverpool UA
measured days	15	23	17	20	26	7	15	33	12
forecasted days	16	33	20	20	25	15	23	28	23
ok (f and m)	19	26	21	24	34	11	23	36	21
wrong (f not m)	6	16	2	1	1	5	4	3	4
wrong (m not f)	0	1	2	1	2	3	0	4	1
success %	127	113	124	120	131	157	153	109	175
accuracy %	76	60	84	92	92	58	85	84	81

AGGLOMERATIONS	Nottingham UA	Portsmouth UA	Sheffield UA	Swansea UA	Tyneside	West Midlands UA	West Yorkshire UA	Overall
measured days	18	54	16	37	18	42	37	390
forecasted days	22	57	24	42	21	33	32	440
ok (f and m)	20	61	27	47	24	46	44	484
wrong (f not m)	6	6	4	3	2	3	1	73
wrong (m not f)	2	3	1	3	0	2	3	28
success %	111	113	169	127	133	110	119	124
accuracy %	71	87	84	89	92	90	92	83

*** All performance statistics are based on provisional data. Obviously incorrect data due to instrumentation faults have been removed from the analyses.**

Please refer to the start of section 3 for an explanation of the derivation of the various statistics, figures >100 % may occur.

Table 3.5 – Summary of episodes April to June 2008 (Based on latest provisional data)

Pollutant	High or above days	Moderate days	Max. conc. (µg /m^3) *	Site with max. conc.	Zones or Agglomeration	Date of max conc.	Forecast success HIGH days (%)*** [no. incidents, zone or agglomeration days] **
Ozone	3	78	204	Wigan Centre	NW and Merseyside zone	11/5	100 % [12]
PM_{10} gravimetric equivalent	1	34	111	Glasgow Kerbside	Glasgow UA	20/4	0 % [1]
NO_2	0	0	260	London Marylebone Road	London	9/5	N/a
SO_2	0	0	263	Narberth	South Wales zone	29/6	N/a
CO	0	0	2.8	Port Talbot Margam	Swansea UA	18/6	N/a

* Maximum concentration relate to 8 hourly running mean or hourly mean for ozone, 24 hour running mean for PM_{10}, hourly mean for NO_2, 15 minute mean for SO_2 and 8 hour running mean for CO (CO units are mg/m3).
** the number of incidents is the total of the number of HIGH days in all zones and agglomerations (ie a HIGH day on the same day in many zones or agglomerations is counted as many incidents, not just one)

*** The success rates for the number of HIGH days in table 3.5 have been calculated using calendar days (ie midnight to midnight) and therefore may not necessarily agree with the success rates calculated within the forecast analysis tables 3.1 and 3.2, which are calculated based on media forecast days starting generally at 3 pm each day.

General Observations

There were 13 zone and agglomeration-day incidents of HIGH band pollution measured during this quarter, one day was for PM_{10} and the rest for ozone which occurred over 3 calendar days. In total, 83 MODERATE days were measured during the quarter. Fifty MODERATE days were measured for ozone alone, 5 days for PM_{10} alone and 28 days for both ozone and PM_{10} on the same day. No MODERATE days were measured for either SO_2 or NO_2.

No MODERATE or above days were measured for CO during the reporting period. The highest 8-hour running mean calculated was 2.8 mg/m^3 at the Port Talbot Margam site and was measured simultaneously with an increase in SO_2, suggesting that the nearby steel works was the source.

Figures 3.1 – 3.2 show the trends of pollutants in graphical form. A site-by-site breakdown is given in Figures 3.4a and 3.4b.

O_3

More than ten sites on the same day measured a MODERATE exceedence from 11th April to 10th June, a time period over which two major episodes occurred.

The first widespread episode of the year was seen from the 5th to 12th May. At its height the HIGH band was reached on 3 consecutive days at a few monitoring locations, based on provisionally scaled datasets. On the 3rd May air reaching the UK had been sourced from over the Atlantic with a degree of circulation over France. By the 4th May the air reaching England and Wales had been sourced from France and Germany and this trend continued up to the end of the episode. By the 13th May, 1-day ahead forecast air mass back-trajectory plots indicated that the air reaching the south of England had originally passed over parts of Europe and Germany, whereas the air reaching other areas had originated from Scandinavia and the Atlantic. Over the whole period maximum daytime temperatures reached the mid 20s degrees C in England, temperatures cooled once the episode had finished. Nearly all sites in the network reached the MODERATE band at some stage during the period of the episode, including sites in London. The highest number of MODERATE band exceedences were measured at the rural sites Ladybower in the Midlands and Great Dun Fell in the north west of England. On the 9th May Hull Freetown reached the HIGH band at index 7, as calculated using provisional scalings, however the response of the instrument is currently under investigation. On the 10th Ladybower reached the lower limit of the HIGH band. At the episode's height, on the 11th May, six sites entered the HIGH band at index 7. These sites were: Wigan Centre, Birmingham Tyburn, the rural sites at Cwmbran, North Wales and Ladybower, Hull Freetown and Exeter Roadside. More than 60 sites exceeded the MODERATE band on a daily basis on six of the seven days between the 6th and 12th May.

The second widespread episode occurred between the 21st and 26th May. On the 20th, the day before the episode started, the incoming air had originated from the Atlantic, to the north. By the 21st some circulation over Belgium and the Netherlands was happening. Similar air mass back-trajectories continued until, by the 26th, the very south of the UK was receiving air from Europe while the rest of the UK was receiving air from Scandinavia. The situation changed further on the following day, the end of the episode, with European sourced air reaching only the South East. During this episode maximum daytime temperatures remained in the low 20's C. Around 50 sites exceeded the MODERATE band on each of the six days. The highest number of MODERATE band exceedences were measured at the rural sites Ladybower (Midlands) and Eskdalemuir (Scottish Borders). 95% of the sites in the network measured a MODERATE exceedence over the episode. The highest measurement was 160 ug/m^3 (index 6) on 22nd May at Ladybower.

On the 24th June, 24 sites entered the MODERATE band, geographically widespread throughout England and Wales, and 40% were rural. Forecast air mass back-trajectories indicated UK-incident air from the Atlantic with some re-circulation of air over the UK with a possibility of some air having passed over the near coast of France. The ambient daytime temperature in England was in the low to mid 20's C on that day and was not exceptional for the trend in June. Thus some of the incoming air may have indeed passed over from France to cause the number of exceedences measured on that day. Relatively unpolluted background air generally reached the UK from mid to late June, the lowest season of the year for ozone formation in the UK and Europe from natural background air.

Figure 3.1 shows the trends in O_3 levels over this period.

PM_{10}

Sites measuring the highest number of MODERATE days during the reporting period were London Maylebone Road (16 days), Scunthorpe Town (10 days), Port Talbot Margam (8 days) and Middlesborough (9 days). The exceedences at Marylebone Road were primarily the result of traffic pollution. Industrial emissions reaching the Port Talbot, Scunthorpe and possibly the Middlesborough monitoring sites were responsible for those exceedences. One HIGH day was measured at Glasgow Kerbside on the 20th April. A timeseries plot suggested that a localised source of particulate pollution had been present for days leading up to the HIGH day. The source was likely to have been traffic-related, possibly idling traffic or taxis.

Four sites or more measured an exceedence over 4 days in May; from the 8th to the 11th. This occurred towards the end of the first ozone episode of the year. Plots of the volatile fraction of PM_{10}, as measured by FDMS instruments, indicated that the contribution of particulate pollution from Europe was at its height on both the 10th and 11th May, the two days with the largest number of MODERATE band exceedences. Sites exceeding the MODERATE band were mainly situated in the north of England and many were located in or near industrial areas. Over three of the MODERATE days, London Marylebone Road and Glasgow Kerbside sites also contributed to the MODERATE exceedences.

Figure 3.2 shows the trends in PM_{10} levels over this period.

NO_2

No MODERATE days were measured during the reporting period, an unusual phenomenon for any reporting quarter. The two highest hourly averages measured were 260 ug/m^3 on the 9th May at London Marylebone Road and 256 ug/m^3 at Glasgow Kerbside on the 30th April.

SO_2

No MODERATE days were measured during the reporting period, an increasingly common phenomenon in recent years. The two highest 15 minute average measurements made during this quarter were 263 ug/m^3 at Narberth, a rural site in the south west of Wales and 261 ug/m^3 at Edinburgh St Leonards. A rise in measurements at the Narberth AQM site started around 9 a.m. on the morning of Sunday 29th June and lasted until the early hours of the following morning. A peak in levels occurred around midday. No obvious source for the pollution has yet been identified, although movement of agricultural vehicles has been cited as a possibility. The pollution is likely to have been carried on the stable south westerly breeze that had been prevalent up to and including that day. A maximum 15 minute average peak was mesasured at 09:30 on Monday 19th May at Edinburgh St Leonards. The rise in measurements started at about 8 a.m. that morning and lasted until about midday. Previous examples of unexpected SO_2 spikes have been occasionally measured at this site in the past and no obvious source has yet to be identified. On this occasion the air was coming from a north easterly direction.

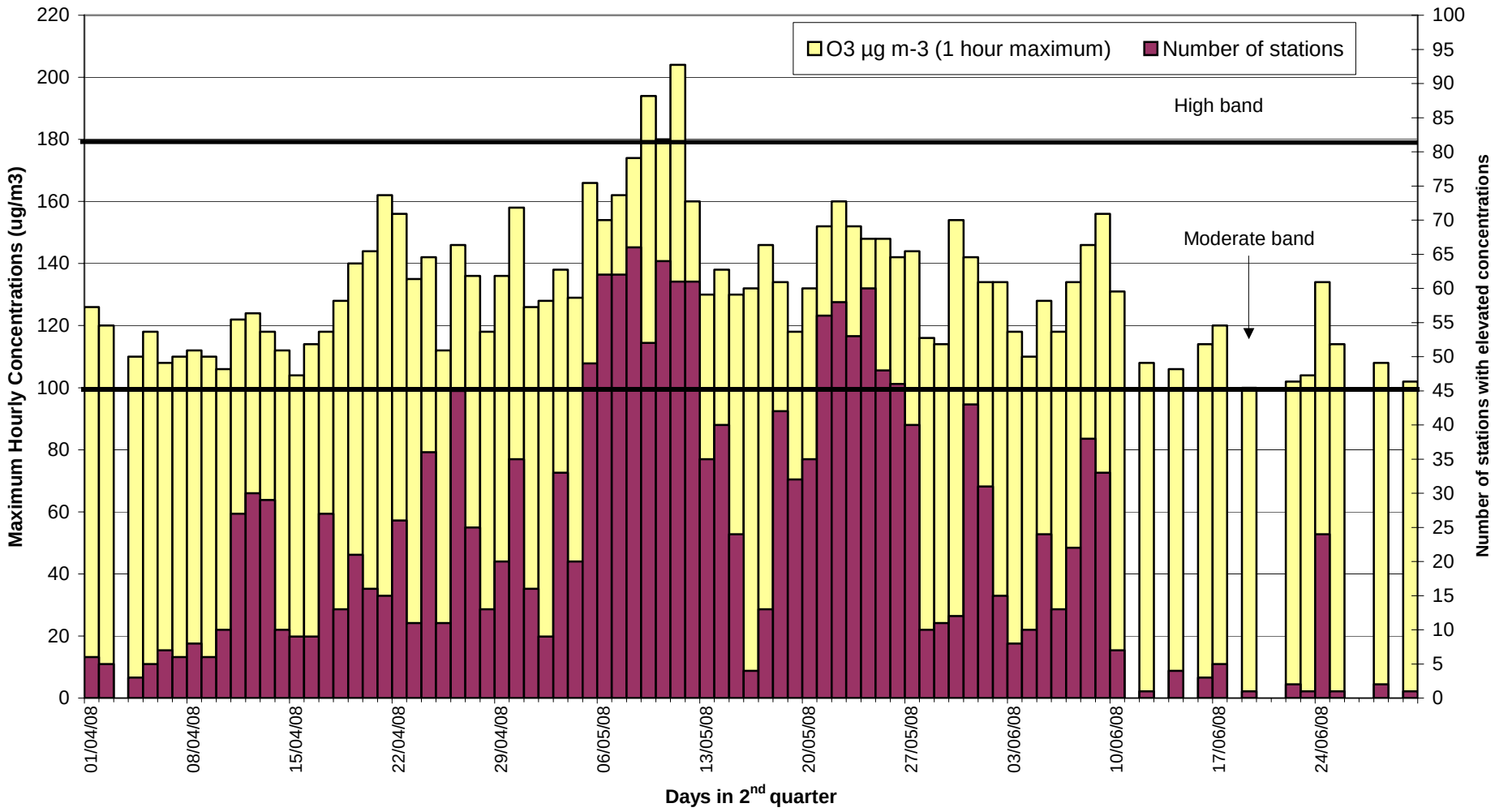

Figure 3.1 Daily maximum hourly ozone concentration across AURN Network with total number of stations measuring MODERATE or above levels of ozone over 2nd quarter 2008.

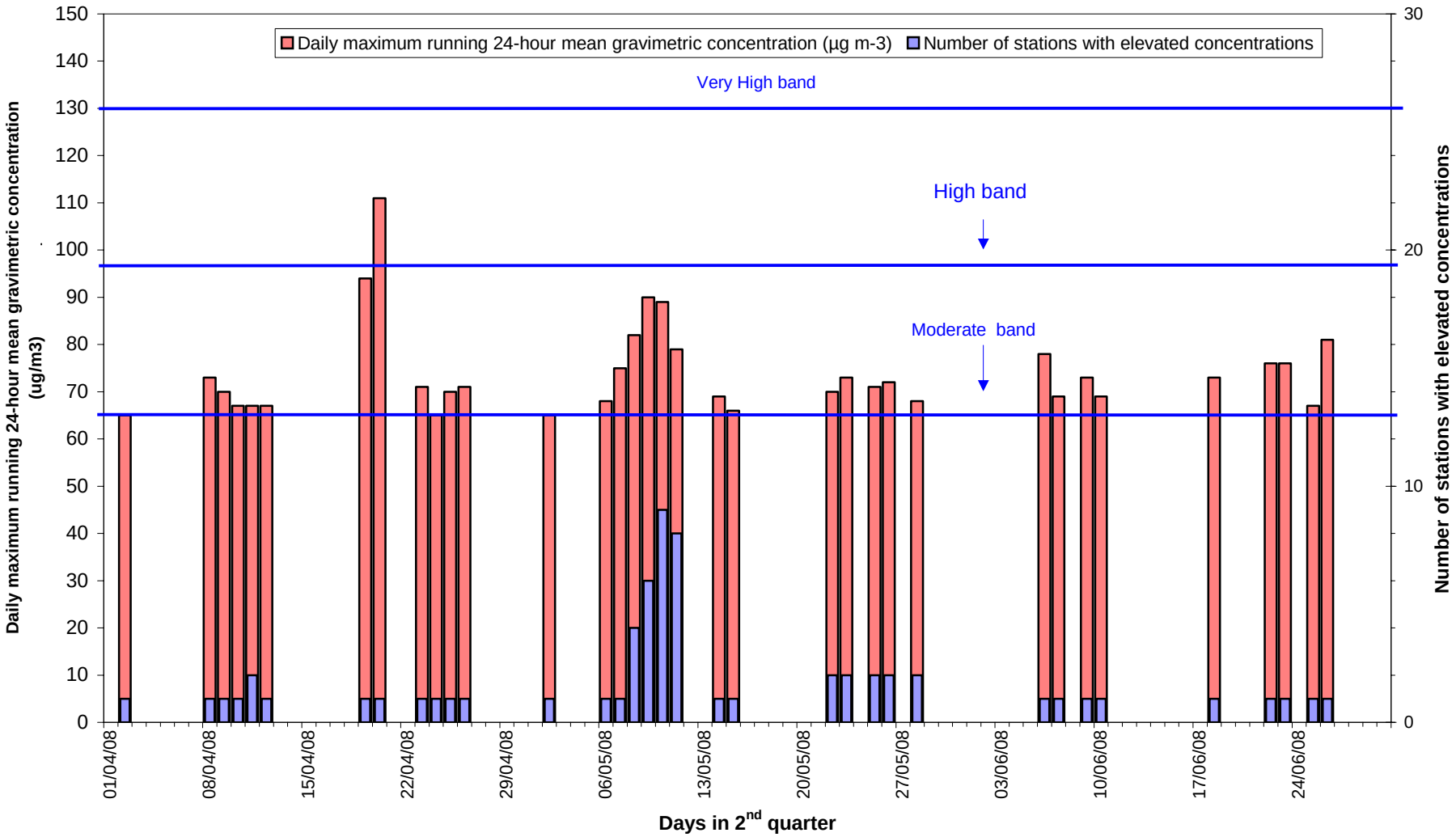

Figure 3.2 Daily maximum running 24-hour mean PM_{10} concentration across AURN Network with total number of stations measuring MODERATE or above levels over the 2nd quarter 2008.

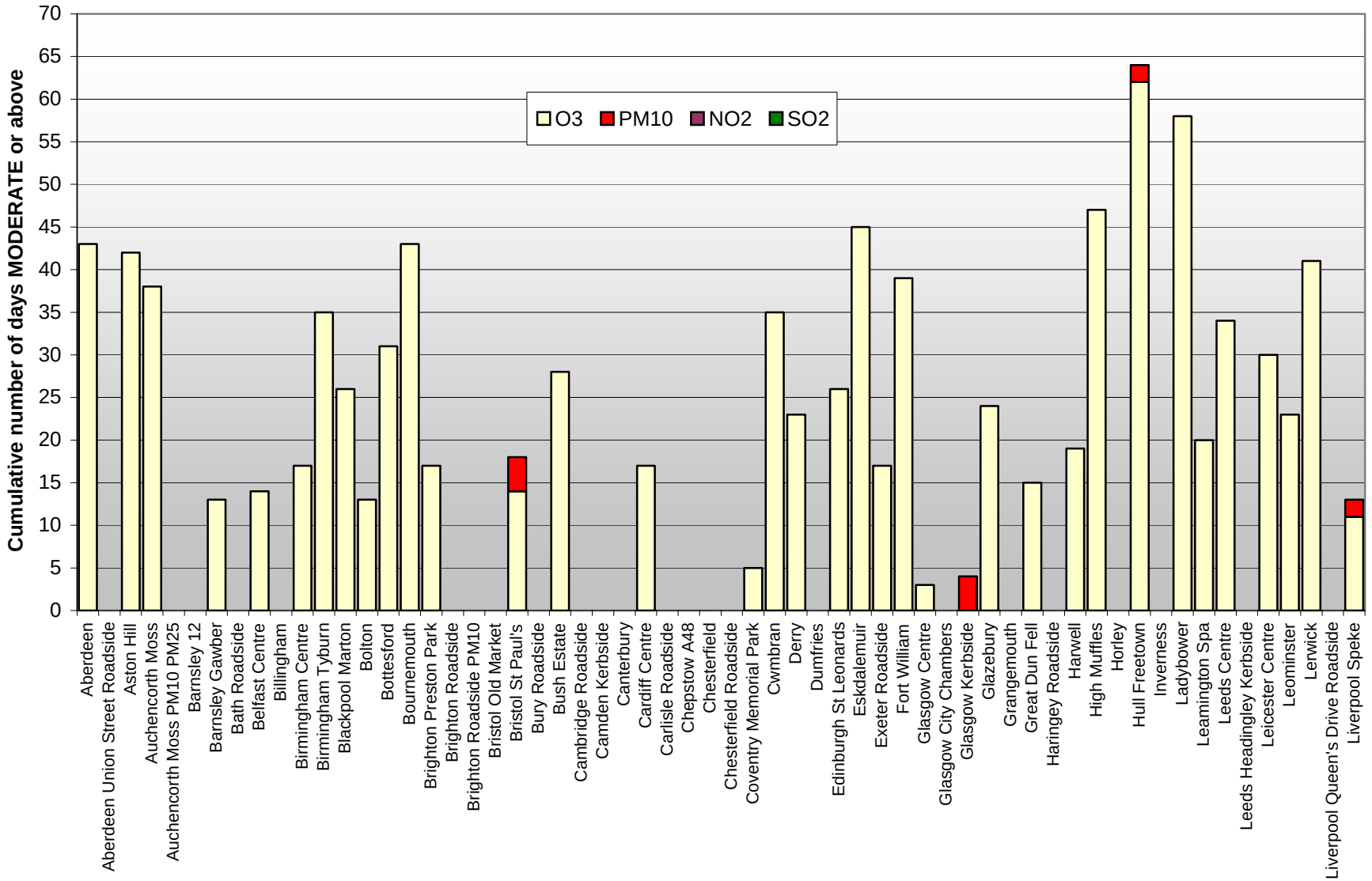

Figure 3.4a Number of days moderate and above for each AURN Network station over 2nd quarter 2008 (sites A to L)– provisional data

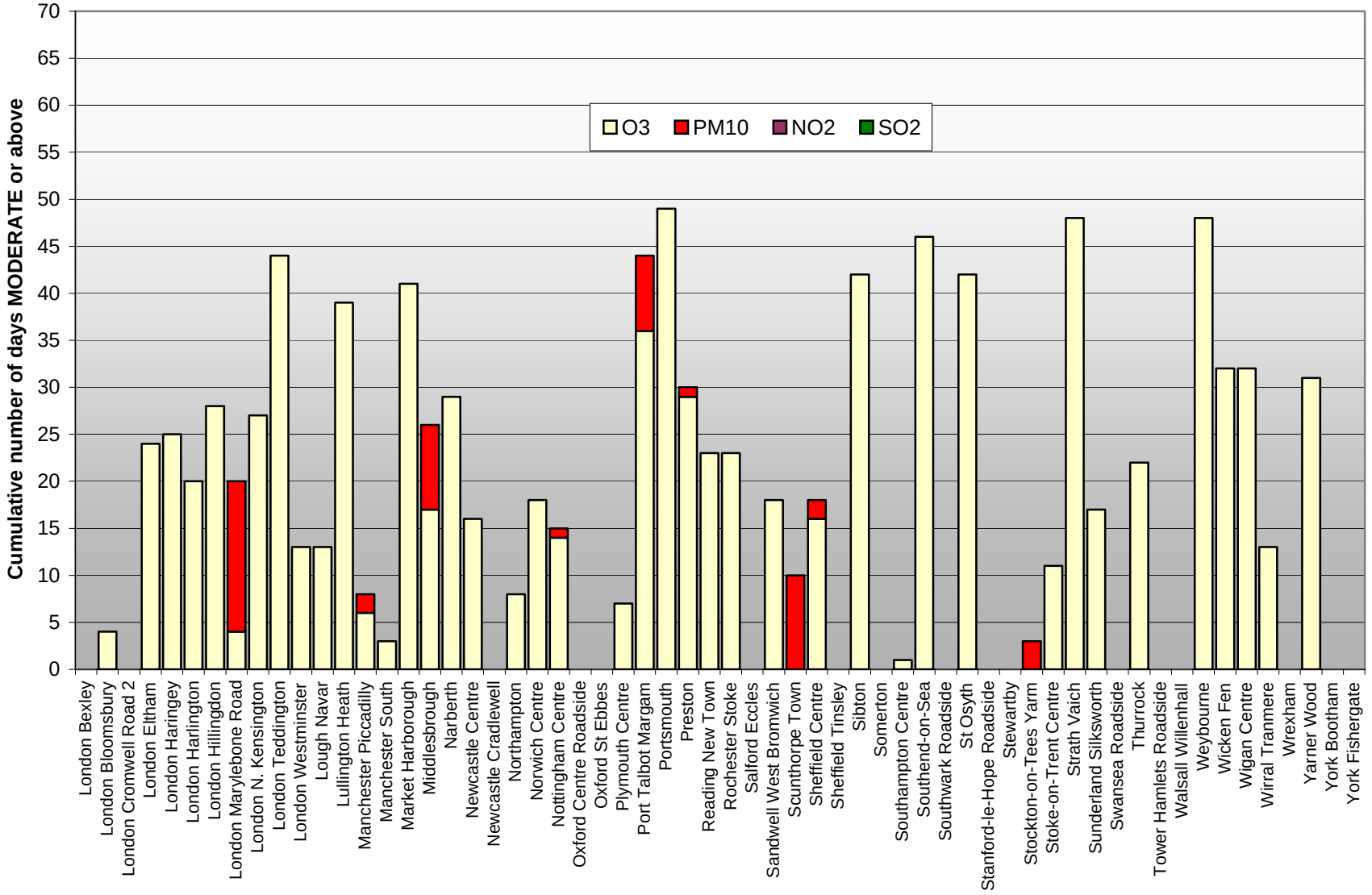

Figure 3.4b Number of days moderate and above for each AURN Network station over 2nd quarter 2008 (sites L to Y) – provisional data

4 Breakdowns in the service

All bulletins were successfully delivered to the Air Quality Communications contractor on time. There were no reported breakdowns in the service over this three-month period.

5 Additional or enhanced forecasts

No formal enhanced forecasts can be issued until the format of the enhanced service has been agreed with Defra and the Devolved Administrations.

The air pollution forecast is always re-issued to Teletext, Web and Freephone services at 10.00 local time each day, but will only be updated when the pollution situation is changing.

The bi-weekly air pollution outlooks have continued to be delivered successfully to Defra and other government departments by email on Tuesdays and Fridays.

6 Ad-hoc services and analysis

A report detailing the UK particulate episode in January, as a result of long-range transport of dust from sandstorms in north-west Africa, was drafted during the reporting quarter and submitted to Defra and the Devolved Administrations.

7 Ongoing research

AEA Energy & Environment and the Met office will also continue to:

1. Investigate ways of using automatic software systems to streamline the activities within the forecasting process, thus allowing forecasters to spend their time more efficiently considering the most accurate forecasts.
2. Research the chemistry used in our models, for example the chemical schemes for secondary PM_{10} and ozone.
3. Improve the NAME model runs that can be used for ad-hoc analyses, in particular with regard to investigating the possible long-range transport of PM_{10} pollution from European sources and the long-range transport of particles from Saharan Dust Storms.
4. Improve and update the emissions inventories used in our models.

8 Project and other related meetings

The Annual Air Pollution Forecasting Seminar

The Seventh National Air Quality Forecast Seminar took place at City Hall in London on Wednesday 14th May 2008. The event was well attended with the 80 available places all taken up. Presentations were made on subjects such as recent air pollution episodes from local UK emissions, modelling the health impacts of episodes and the influence of long-range transport in recent UK air pollution events.

All the presentations have been published on the National Air Quality Archive website at http://www.airquality.co.uk/archive/reports/list.php under the Air Pollution Forecasting section.

9 Forward work plan for July to September 2008

Major tasks include:

- Ongoing daily air pollution forecasting activities.
- Ongoing improvements to the NAME model, including:
  - Increase in the horizontal model domain
  - An upgrade providing enhanced chemistry modelling for ozone, nitrates and sulphates.
  - Update of emissions inventory used in the model.
- Publication of the annual 2007 report and an ad-hoc report detailing a UK particulate episode in January 2008 on the Air Quality Archive Web Site.

10 Hardware and software inventory

Defra and the Devolved Administrations own the code for the ozone and secondary PM_{10} models, but not the graphical interface for these. Defra and the Devolved Administrations own the software for delivering the air pollution forecast to the Air Quality Communications system. Defra and the Devolved Administrations also own the web pages used to display the forecasts.

No computer hardware currently being used on this project is owned by Defra or the Devolved Administrations.

Appendix 1 - Air Pollution Index

CONTENTS

The UK Air Pollution Indices

Old Banding	Index	Ozone 8-hourly / Hourly mean		Nitrogen Dioxide Hourly Mean		Sulphur Dioxide 15-Minute Mean		Carbon Monoxide 8-Hour Mean		PM_{10} Particles 24-Hour Mean*
		μgm^{-3}	ppb	μgm^{-3}	ppb	μgm^{-3}	ppb	mgm^{-3}	ppm	gravimetric μgm^{-3}
LOW										FDMS limits / TEOM limits
	1	0-32	0-16	0-95	0-49	0-88	0-32	0-3.8	0.0-3.2	0-19 / 0-21
	2	33-66	17-32	96-190	50-99	89-176	33-66	3.9-7.6	3.3-6.6	20-40 / 22-42
	3	67-99	33-49	191-286	100-149	177-265	67-99	7.7-11.5	6.7-9.9	41-62 / 43-64
MODERATE										
	4	100-126	50-62	287-381	150-199	266-354	100-132	11.6-13.4	10.0-11.5	63-72 / 65–74
	5	127-152	63-76	382–477	200-249	355-442	133-166	13.5-15.4	11.6-13.2	73-84 / 75–86
	6	153-179	77-89	478-572	250-299	443-531	167-199	15.5-17.3	13.3-14.9	85-94 / 87-96
HIGH										
	7	180-239	90-119	573-635	300-332	532-708	200-266	17.4-19.2	15.0-16.5	95-105 / 97-107
	8	240-299	120-149	636-700	333-366	709-886	267-332	19.3-21.2	16.6-18.2	106-116 / 108-118
	9	300-359	150-179	701-763	367-399	887-1063	333-399	21.3-23.1	18.3-19.9	117-127 / 119-129
VERY HIGH										
	10	≥ 360 μgm^{-3}	≥ 180 ppb	≥ 764 μgm^{-3}	≥ 400 ppb	≥1064 μgm^{-3}	≥ 400 ppb	≥ 23.2 mgm^{-3}	≥ 20 ppm	≥ 128 / ≥ 130μgm^{-3}

Old Banding	New Index	Health Descriptor
LOW		
	1	Effects are unlikely to be noticed even by individuals who know they are sensitive to air pollutants
	2	
	3	
MODERATE		
	4	Mild effects unlikely to require action may be noticed amongst sensitive individuals
	5	
	6	
HIGH		
	7	Significant effects may be noticed by sensitive individuals and action to avoid or reduce these effects may be needed (e.g. reducing exposure by spending less time in polluted areas outdoors). Asthmatics will find that their “reliever inhaler is likely to reverse the effects on the lung.
	8	
	9	
VERY HIGH		
	10	The effects on sensitive individuals described for “HIGH” levels of pollution may worsen.

* the PM10 banding and index thresholds were revised in June 2007 to accommodate the introduction of a new, enhanced measurement technique (FDMS).

Appendix 2 - Forecasting Zones and Agglomerations

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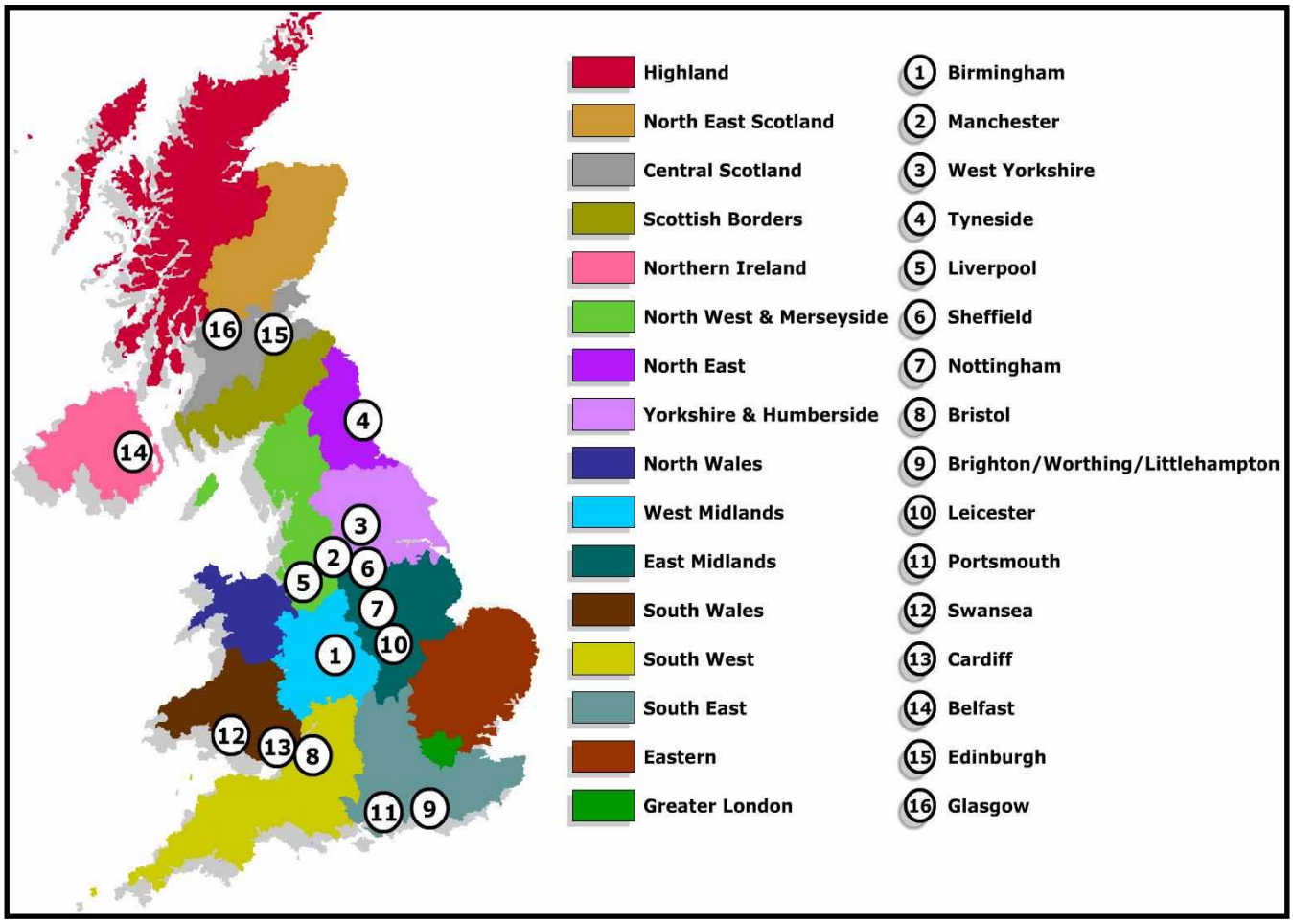
Forecasting Zones

Zone	Population
East Midlands	3084598
Eastern	5119547
Greater London	8278251
North East	1635126
North West and Merseyside	3671986
South East	6690881
South West	4364704
West Midlands	2970505
Yorkshire and Humberside	2816363
South Wales	1578773
North Wales	720022
Central Scotland	1813314
Highland	380062
North East Scotland	1001499
Scottish Borders	254690
Northern Ireland	1104991

Forecasting Agglomerations

Agglomeration	Population
Brighton/Worthing/Littlehampton	461181
Bristol Urban Area	551066
Greater Manchester Urban Area	2244931
Leicester	441213
Liverpool Urban Area	816216
Nottingham Urban Area	666358
Portsmouth	442252
Sheffield Urban Area	640720
Tyneside	879996
West Midlands Urban Area	2284093
West Yorkshire Urban Area	1499465
Cardiff	327706
Swansea/Neath/Port Talbot	270506
Edinburgh Urban Area	452194
Glasgow Urban Area	1168270
Belfast	580276

Map of UK forecasting zones and agglomerations



Appendix 3 – Worked Example of How UK Forecasting Success and Accuracy Rates are Calculated.

CONTENTS

A worked example showing how forecasting accuracy and success rate are defined and calculated in this report

This analysis is based on an imaginary period of high pollution concentrations in South East England – which occurred during warm weather and resulted in the formation of photochemical ozone. There were 4 days on which HIGH concentrations were measured; 29th July, 30th July, 1st August and 2nd August. Over the slightly longer period from 29th July – 3rd August, there were 6 days on which HIGH levels were either measured or forecast. During the whole reporting period, there were no other observations of HIGH band measurements, either forecast or actual. 31st July was a cooler day and measurements did not reach the HIGH band, despite being forecasted. Measured air pollution and previous day forecast are shown below for each day during this period, in terms of index and descriptive bands:

Date	28/7	29/7	30/7	31/7	1/8	2/8	3/8	4/8
Measured Index value (M)	**5** (MOD)	7 (HIGH)	7 (HIGH)	6 (MOD)	7 (HIGH)	7 (HIGH)	5 (MOD)	5 (MOD)
Forecast Index value (F)	5 (MOD)	6 (MOD)	7 (HIGH)	7 (HIGH)	8 (HIGH)	5 (MOD)	7 (HIGH)	6 (MOD)

Based on the figures above, the success and accuracy of predicting HIGH episodes (>= Air Pollution index 7) for the South East Zone may be analysed as shown below:

Date	28/7	29/7	30/7	31/7	1/8	2/8	3/8	4/8
Measured Index value (M)	**5** (MOD)	7 (HIGH)	7 (HIGH)	6 (MOD)	7 (HIGH)	7 (HIGH)	5 (MOD)	5 (MOD)
Forecast Index value (F)	5 (MOD)	6 (MOD)	7 (HIGH)	7 (HIGH)	8 (HIGH)	6 (MOD)	7 (HIGH)	6 (MOD)
HIGH forecast or measured	No, so not used in calculations	Yes	Yes	Yes	Yes	Yes	Yes	No, not used in calcs
OK- Agreement of F and M to +/- 1 index band	N/A	Yes	Yes	Yes	Yes	Yes	No	N/A

HIGH days measured	4
HIGH days forecast	4
OK (M and F) [i.e. Agreement of F and M to +/- 1 index band	5
Wrong (F not M)	1
Wrong (M not F)	0

The forecasting **success** during this period is calculated as:

[OK (M and F) / HIGH days measured]*100 = [5/4]*100 **= 125 %**

The corresponding **accuracy** is calculated as:

[OK (M and F) / {OK (M and F) + Wrong (M not F) + Wrong (F not M)}]*100

= [5 / {5+0+1}]*100 = [5/6]*100 = **83**

The analysis is then repeated for each of the 16 UK zones and 16 UK agglomerations.