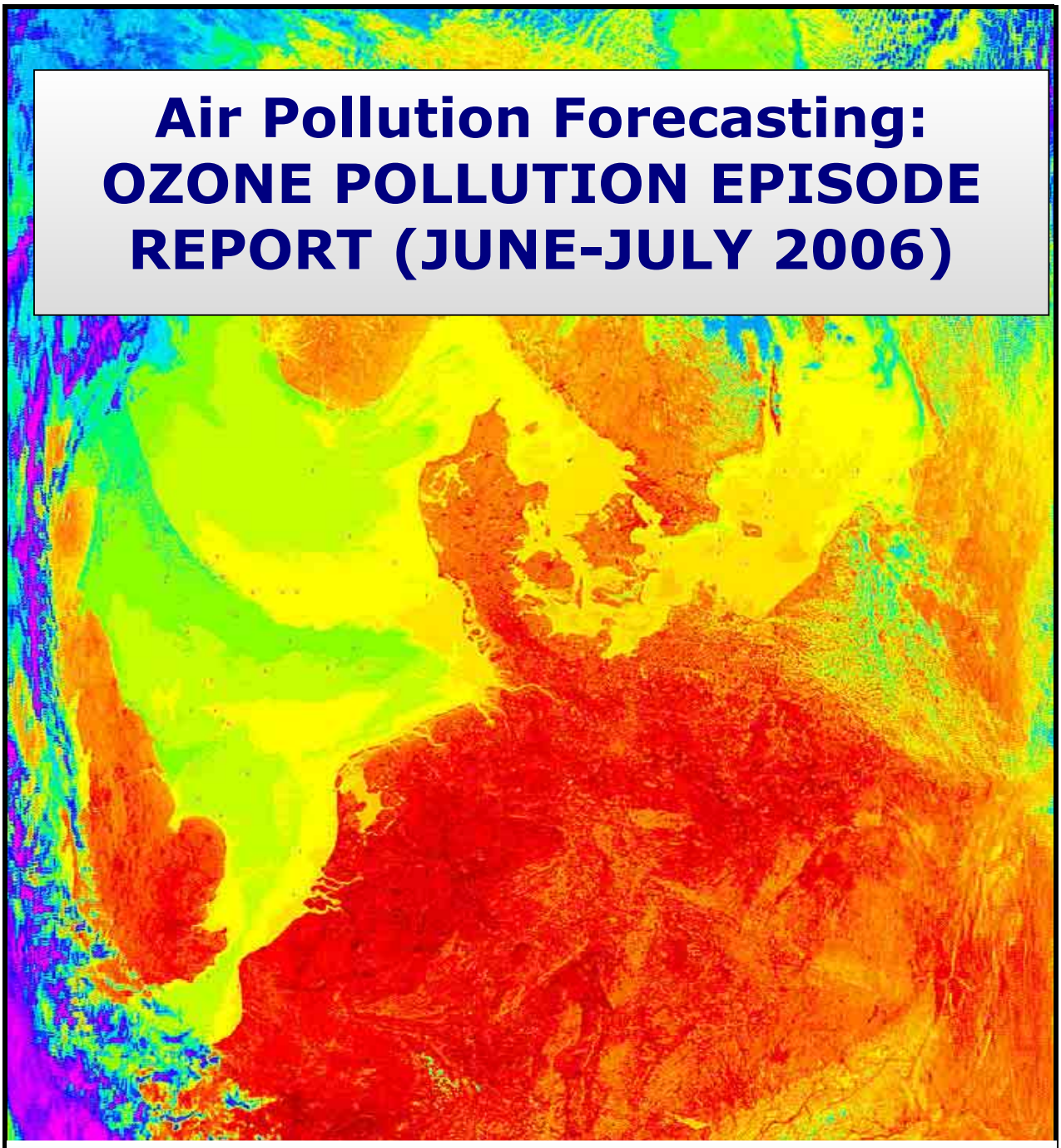
REPORT

Air Pollution Forecasting: OZONE POLLUTION EPISODE REPORT (JUNE-JULY 2006)



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

AEA TECHNOLOGY ENVIRONMENT

AEA/ENV/R/2168
Issue 1 August 2006

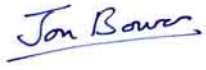
Air Pollution Forecasting: OZONE POLLUTION EPISODE REPORT (JUNE-JULY 2006)

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

AEA/ENV/R/2168 Issue 1
August 2006

Title	Air Pollution Forecasting: OZONE POLLUTION EPISODE REPORT (JUNE-JULY 2006)
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
Confidentiality, copyright and reproduction	
File reference	ED 48692
Report number	AEA/ENV/R/2168 Issue 3
Report status	Issue 1

AEA Technology Environment
National Environmental Technology Centre (Netcen)
B551 Harwell
Didcot
Oxon OX11 0QJ
Telephone 0870 190 6669
Facsimile 0870 190 6607
Netcen is an operating division of AEA Technology plc
AEA Technology is certificated to BS EN ISO9001:(1994)

	Name	**Signature**	**Date**
Authors	Jaume Targa		22 August 2006
Reviewed by	Jon Bower		30 August 2006
Approved by	Paul Willis		1 Sept 2006

Front cover image: Modis Satellite Image showing Temperature on 19th July 2006 at 10:35 UTC

Executive Summary

This is the most recent in a series of reports for Defra and the Devolved Administrations that describe major UK air pollution episodes.

HIGH levels of air pollution were measured across the Automatic Urban and Rural Network (AURN) during June and July 2006. During this period, HIGH ozone levels were measured at sixty AURN stations.

July's heatwave across Europe resulted in elevated ozone levels in the UK, primarily in England and Wales. The AURN recorded ozone levels in Defra index 8 HIGH band (240-299 μgm^{-3}) at three stations: Wicken Fen, London Haringey and Blackpool Marton. The highest hourly concentration was measured at 278 μgm^{-3} (index 8) on the 19th July at Wicken Fen at 18.00.

The 3rd Daughter Directive (Directive 2002/3/EC) on ozone in ambient air established an alert threshold of 240 μgm^{-3} was exceeded at Wicken Fen on 19th July when 8 consecutive hours were measured above 240 μgm^{-3}.

High ozone levels resulted from high temperatures across England and Wales, coupled with re-circulation of air masses over Europe and the UK. High ozone levels were measured across local air quality networks as well as across continental Europe.

Elevated levels of PM_{10} were also measured in June-July, together with elevated SO_2 levels in July; these were mostly in London and South East England.

Main causative factors and the phenomenology of the episode are described in detail in this report.

Contents

1 Introduction

Elevated ozone levels are usually observed during periods with sustained high temperatures and sunshine levels. This is because the photochemical reactions in the atmosphere that produce ozone are favoured by such conditions. Because these reactions can take some time to proceed, transport of ozone and its precursors can also exert a strong influence on UK ozone levels. High temperatures, coupled with the re-circulation of air masses over Europe and the UK are often conducive to ozone pollution episodes.

HIGH levels of air pollution were measured across the Automatic Urban and Rural Network (AURN) during June and July 2006. During this period, HIGH ozone levels were measured at sixty AURN stations. Ozone levels were particularly high in July.

The July heatwave resulted in elevated ozone levels in England and Wales. The AURN recorded ozone levels in Defra index 8 HIGH band (240-299 μgm^{-3}) at three stations: Wicken Fen, London Haringey and Blackpool Marton. The highest hourly concentration was measured at 278 μgm^{-3} (index 8) on the 19th July at Wicken Fen at 18.00. These levels are higher than those observed during the well-documented heatwave of August 2003.

The 3rd Daughter Directive (Directive 2002/3/EC) on ozone in ambient air has established an alert threshold of 240 μgm^{-3} as an hourly average over three consecutive hours. This alert threshold was exceeded at Wicken Fen on 19th July, when 8 consecutive hours were measured above 240 μgm^{-3}.

This report which is based on PROVISIONAL MONITORING DATA, provides comprehensive information on:

- Defining the episodes (Section 2)
- Weather conditions during June and July (Section 3)
- Air quality monitoring (Section 4)
- Air quality forecasting (Section 5)
- Reasons for the ozone episodes (Section 6)
- The ozone episodes across Europe (Section 7)
- Other pollutants during heat wave 2006 (Section 8)
- Conclusions (Section 9).

2 Defining the episodes

Summer ozone episodes can sometimes be hard to delimit, because ozone levels are often in the moderate band during much of the summer season. Near-moderate ozone levels were measured at one or more Automatic Urban and rural Network (AURN) station throughout the period between June and July 2006. However, high ozone levels were measured on seventeen days. These may conveniently be broken into three discrete episodes (these may include some days where the episode was building up):

- 9th –12th June 2006
- 29th June – 6th July 2006
- 16th – 27th July 2006

Figure 1 shows the geographical extend of monitoring stations measuring high levels across England and Wales. Sixty stations in the AURN recorded HIGH levels of ozone between June and July 2006.

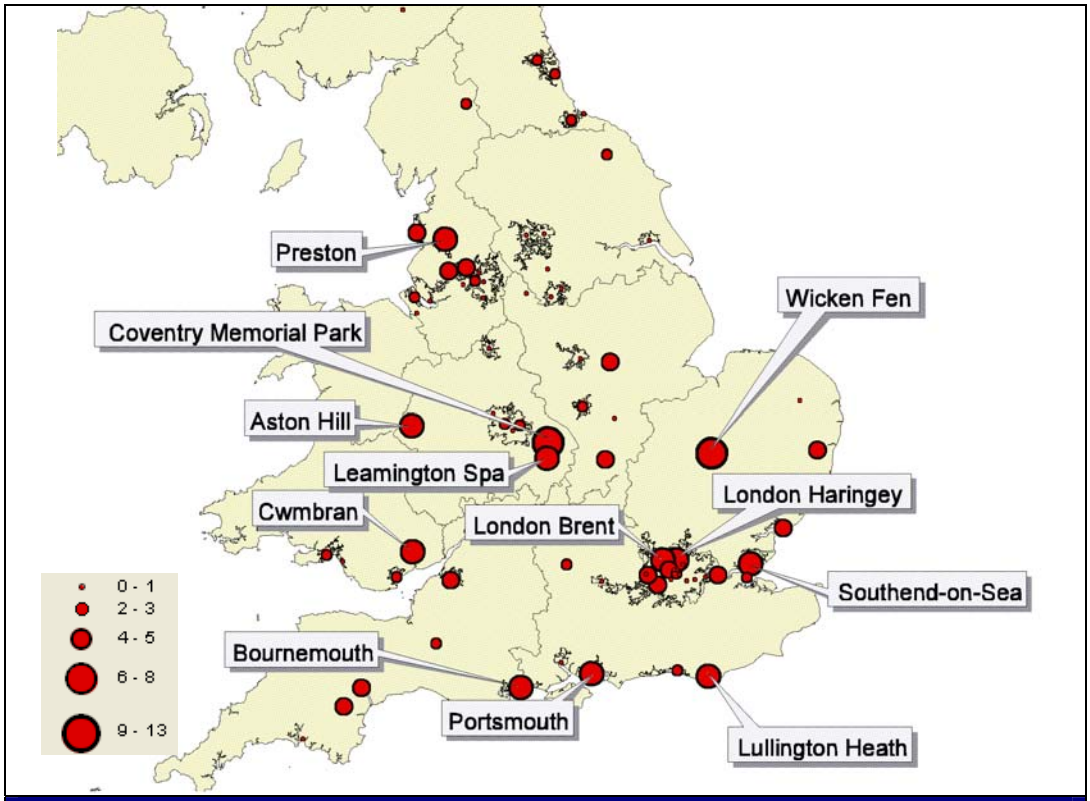


Figure 2.1 – Number of high ozone days across AURN stations in England and Wales

Ozone maximum hourly mean concentrations for all AURN stations across the UK are shown in figure 2.2. As can be seen, high ozone levels across the AURN delimit the extent of each of the three ozone episodes included in this report.

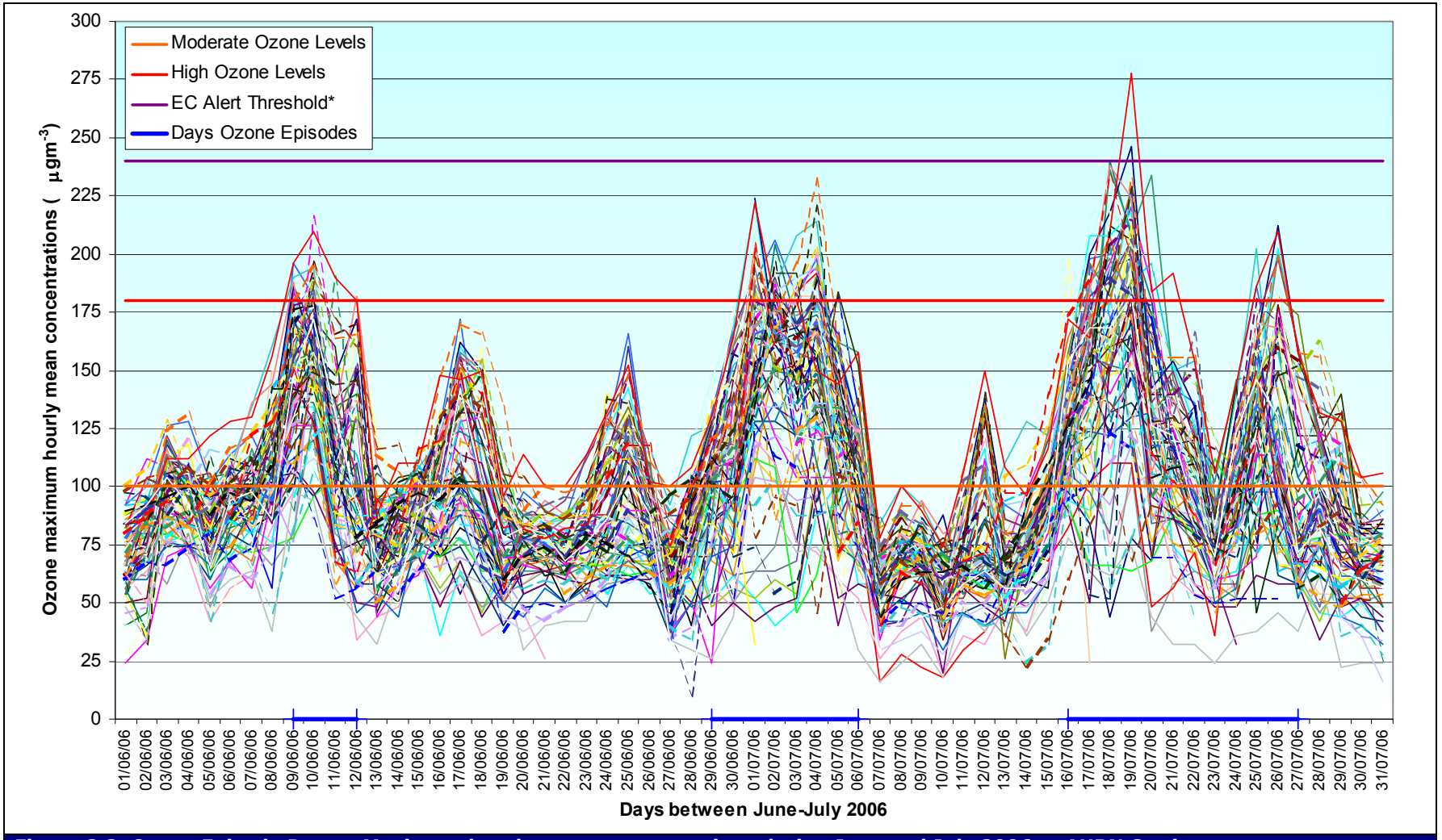


Figure 2.2. Ozone Episode Days – Maximum hourly mean concentrations during June and July 2006 at AURN Stations.

** The 3rd Daughter Directive (Directive 2002/3/EC) on ozone in ambient air established an alert threshold of 240 µgm-3 as an hourly average over three consecutive hours.*

3 Weather Conditions

The weather conditions across England and Wales during the period between June and July were very warm and dry. July was exceptionally hot, with temperatures of 36°C on 19th July setting a new UK July temperature record. By contrast, temperatures across Scotland and Northern Ireland were much cooler. Table 3.1 below shows the monthly weather summaries produced by the Met Office for June and July.

Table 3.1 – Monthly weather summaries for June and July 2006 (Met Office)

June	July
A very warm, dry and sunny month across most areas. Mean temperatures generally 1-2°C above average. Rainfall ranging from close to average across western Scotland, to exceptionally below average across the Midlands. Sunshine levels well above average across southern England. *Central London recorded a maximum temperature of 32.4 C on 12th. Altnaharra recorded a minimum temperature of -1.4 °C and Kinbrace -1.7 C on 26th (both Highlands).*	An exceptionally warm month. Many areas had their warmest July, with some areas also experiencing their warmest month (using a real series back to 1914). Sunshine was also exceptionally above average, with the sunniest areas compared to average over north-east England. Rainfall was generally below average, although there were some notable exceptions. *Wisley recorded a temperature of 36.5 °C on 19th July setting a new UK July temperature record. Penhow recorded a temperature of 34.2 °C on 19th July, setting a new Welsh July temperature record.*

Source: http://www.meto.gov.uk/climate/uk/2006/index.html

Monthly assessments from the Met Office reflect the change of weather conditions during June and July. The ozone episode periods are characterised by atypically high temperatures across England and Wales during June and July, with cool temperatures across northern parts of the UK. Table 3.2 shows a more detailed description of the three episodes identified in the previous section:

- 9th –12th June 2006
- 29th June – 6th July 2006
- 16th – 27th July 2006

Table 3.2 – Weather weekly assessments during ozone episodes from the Met Office

Episode 1: 9th – 12th June
***1st to 10th June*: High pressure dominated the weather through this period**, *centred off southern Ireland on the 1st but migrating over the North Sea by the 5th. Many places stayed dry with good spells of sunshine, Tenby (Pembrokeshire) recording 14.5 hours on the 2nd, but thundery showers developed over the Midlands and southern England on the 4th and the 7th.* ***Temperatures were generally on the warm side, reaching 25.3 °C at Southampton (Hampshire) on the 4th and 27 °C in Ross-on-Wye (Herefordshire) on the 8th**. Onshore winds made it cooler on the east coast at times, the temperature only reaching 10 °C at Lowestoft (Suffolk) on the 1st and 12.6 °C at Loftus (Redcar and Cleveland) on the 5th. The night of the 5th / 6th recorded a ground frost across parts of Norfolk and Lincolnshire.*

11th to 15th June: *A more unsettled spell as a cold front slowly moved across the area and became stationary over south-east England on the 13th and 14th. This brought some welcome rain to most places, over 25 mm falling in parts of Devon on the night of the 11th / 12th. On the 12th temperatures hit 32.4 °C in central London and the heat in the south and east set of thunderstorms across the Midlands and Yorkshire. 30 mm of rain fell at Folkestone (Kent) on the 14th with temperatures at Margate (Kent) only reaching 13.4 °C. The same day behind the cold front Falmouth (Cornwall) was sunny with a temperature of 20.6 °C.*

Episode 2: 29th June– 6th July

28th to 30th June: High pressure kept southern and eastern counties of England dry, very warm and sunny, temperatures reaching 29.2 °C in central London on the 30th. In contrast it was cloudier at times further north and west as a waving cold front ran across Ireland and sent showery outbreaks of rain over north-west England and north Wales, with temperatures only reaching 19 °C on Anglesey.

1st to 4th July: The 1st was sunny with very warm south-east winds. Overnight thundery showers drifted north into south-west England. On the 2nd south-west England, the West Country, the Midlands and north-west England had torrential thundery downpours and large hail. Rochdale (Greater Manchester) logged 43.8 mm in the 12 hours to 2100 UTC. **At Heathrow Airport the temperature reached 32.3 °C**. The 3rd brought further thundery showers to southwest England, south-west Wales and Cumbria. St Bee's Head (Cumbria) recorded 18.6 mm in the hour ending 1900 UTC. The 4th brought locally heavy and thundery rain to southwest England and southwest Wales. Later in the day, thundery showers drifted north from Sussex into central England, with reports of local flooding and hail in Luton, Bedfordshire.

5th and 6th July: On the 5th a band of heavy and thundery showers spread out of France eventually extending from south-west England to the Humber. Intense showers developed over Wales and the north Pennines in the afternoon. Overnight into the 6th parts of Oxfordshire, Buckinghamshire, Wiltshire and Somerset had very heavy rain with 39 mm of rain falling at Brize Norton (Oxfordshire) in the hour to 0600 UTC and 54 mm in 12 hours ending 0900 UTC on the 6th. By afternoon heavy showers and thunder developed over eastern and central England with downpours in Lincolnshire.

Episode 3: 16th – 27th July

13th to 19th July: The 13th started chilly with just 4.1 °C at Redesdale Camp (Northumberland). High pressure became established again over the UK on the 14th, lasting until the 18th. A dust devil was reported at Linton-on-Ouse (North Yorkshire) at 1100 UTC on the 14th. On the mornings of the 14th and 15th parts of northern England had a ground (grass) frost and on the morning of the 15th a ground frost was recorded as far south as Shawbury (Shropshire). **Temperature values peaked on the 19th when 36.5 °C was recorded at Wisley (Surrey) and this set a new temperature record in the UK for July. A number of places broke their July temperature records, for example, Heathrow with 35.5 °C**. The east and south coasts of England were kept cooler by onshore breezes with just 19.8 °C at Boulmer (Northumberland) on the 19th. Some rain clipped western fringes later on the 19th with thunder brushing the Isles of Scilly, east Kent and East Anglia in the evening.

20th to 22nd July: There was some rain on the 20th. Thundery showers developed over parts of East Anglia in the afternoon and again the following evening. Thunderstorms across southern counties in the early hours of the 22nd gave downpours. Severe storms formed during the day from central Southern England into the Midlands and later north-east England, covering a vast area. Many places recorded over 25 mm of rain in a short period and Monks Wood (Cambridgeshire) logged 30.2 mm of rain in the hour to 1500 UTC. At Brize Norton (Oxfordshire) between 1200 and 1300 UTC the temperature fell from 25.4 °C to 17.2 °C. At Cranwell (Lincolnshire) a gust of 54 knots was recorded at 0900 UTC.

23rd to 28th July: **A weakening band of rain spread east on the 23rd.** The 24th was hot and sunny for most. Some light rain over East Anglia and the south-east on the 25th cleared to leave plenty of sunshine. **There were some thundery showers across the southern half of England overnight and across East Anglia and the south-east the next afternoon and evening, with hail in places, and some very heavy rain over parts of Cambridgeshire. On the 27th there were further thunderstorms over southern England and in eastern counties as far north as Lincolnshire which gave very heavy rain in Surrey, flooding in Milton Keynes, and contributed to a landslip on the London Underground towards Heathrow. Cranwell (Lincolnshire) recorded a gust of 60 knots.** Throughout this period it was still very warm or hot with 34 °C in central London on the 26th

Source: Met Office (http://www.meto.gov.uk/climate/uk/2006/)

4 Air quality monitoring

4.1 UK NATIONAL AURN NETWORK

The AURN network continued to monitor air pollution during June and July 2006 with no interruption. As discussed in section 2, moderate ozone levels were measured though June and July, with three defined periods with high ozone levels.

Figure 4.1 shows the number of AURN stations that measured moderate and high ozone levels during June and July. The highest hourly ozone concentration measured was 278 μgm^{-3} at Wicken Fen on 19th July. During the 61-day period covered in this report, Wicken Fen measured HIGH ozone levels for 13 days and MODERATE for 40 days. The highest ozone levels were recorded during the third episode between 16th-26th July.

Twelve AURN stations measured HIGH ozone levels for more than five days. Maximum hourly concentrations ranged between 278 μgm^{-3} (Wicken Fen), 246 μgm^{-3} at London Haringey and 238 μgm^{-3} at Lullington Heath. Table 4.1 shows the number of days measuring high or moderate ozone levels across the AURN. The maximum hourly mean concentrations and the date of its measurement are also shown. Figure 4.2 shows the maximum hourly ozone mean concentrations for these twelve AURN stations. The majority of maximum hourly mean concentrations were measured between the 18th and 19th of July, others were measured in early July and a minority during early June.

Table 4.1. Number of days of Moderate and High levels at each station across the AURN between June and July 2006

Site	Number of Days		Max hourly (μgm^{-3}) *provisional*	Date of hourly max concentration
	High	Moderate		
Wicken Fen	**13**	**40**	**278**	**19/07/06**
Coventry Memorial Park	**10**	**31**	**220**	**19/07/06**
Southend-on-Sea	**8**	**38**	**232**	**04/07/06**
Cwmbran	**8**	**30**	**226**	**19/07/06**
London Haringey	**6**	**25**	**246**	**19/07/06**
Lullington Heath	**6**	**29**	**238**	**18/07/06**
Bournemouth	**6**	**21**	**232**	**18/07/06**
Portsmouth	**6**	**27**	**230**	**18/07/06**
Leamington Spa	**6**	**25**	**228**	**19/07/06**
London Brent	**6**	**28**	**222**	**01/07/06**
Aston Hill	**6**	**26**	**220**	**19/07/06**
Preston	**6**	**19**	**218**	**18/07/06**
Blackpool Marton	5	25	240	18/07/06
Northampton	5	25	214	19/07/06
London Teddington	5	32	206	19/07/06
Bristol St Paul's	5	14	202	19/07/06
London N. Kensington	5	28	200	26/07/06
Yarner Wood	4	21	234	18/07/06
Thurrock	4	33	228	19/07/06
Exeter Roadside	4	14	208	18/07/06
St Osyth	4	33	206	19/07/06

London Harlington	4	28	206	19/07/06
Bolton	4	23	198	19/07/06
Bottesford	4	27	196	20/07/06
Sibton	4	32	194	04/07/06
Wigan Centre	4	19	190	18/07/06
Great Dun Fell	3	22	236	18/07/06
Wirral Tranmere	3	18	210	18/07/06
Brighton Preston Park	3	28	206	18/07/06
Cardiff Centre	3	15	198	19/07/06
High Muffles	3	29	192	02/07/06
Leicester Centre	3	26	192	02/07/06
Middlesbrough	2	21	216	10/06/06
Harwell	2	24	212	18/07/06
Somerton	2	26	202	04/07/06
Sunderland Silksworth	2	21	202	18/07/06
Rochester	2	32	200	04/07/06
Sandwell West Bromwich	2	22	198	19/07/06
London Westminster	2	30	192	01/07/06
Swansea	2	24	192	19/07/06
Leominster	2	22	192	04/07/06
Birmingham Tyburn	2	25	186	19/07/06
Newcastle Centre	2	19	184	02/07/06
Salford Eccles	2	13	182	10/06/06
London Bexley	1	26	212	19/07/06
Stoke-on-Trent Centre	1	20	200	19/07/06
Reading New Town	1	29	198	16/07/06
Norwich Centre	1	33	196	10/06/06
Derry	1	6	196	19/07/06
Weybourne	1	24	188	10/06/06
Liverpool Speke	1	17	188	19/07/06
Belfast Centre	1	5	188	19/07/06
London Wandsworth	1	29	182	26/07/06
Barnsley Gawber	1	23	182	17/07/06
Wolverhampton Centre	1	17	182	19/07/06
London Hillingdon	1	16	182	19/07/06
Strath Vaich	1	16	182	19/07/06
Market Harborough	1	32	180	10/06/06
Redcar	1	26	180	18/07/06
Nottingham Centre	1	21	180	17/07/06
London Eltham	0	32	178	26/07/06
Port Talbot	0	23	178	04/07/06
London Bloomsbury	0	22	178	26/07/06
Ladybower	0	25	176	10/06/06
Eskdalemuir	0	17	176	19/07/06
London Hackney	0	9	174	09/06/06
Birmingham Centre	0	24	170	02/07/06
Lough Navar	0	6	170	19/07/06
Hull Freetown	0	26	168	02/07/06
Bush Estate	0	11	166	10/06/06

Manchester South	0	17	164	17/07/06
Bradford Centre	0	10	164	01/07/06
Fort William	0	6	162	19/07/06
Narberth	0	14	160	04/07/06
Southampton Centre	0	13	160	01/07/06
Rotherham Centre	0	12	158	17/07/06
Leeds Centre	0	18	154	03/07/06
London Lewisham	0	25	152	18/07/06
Bury Roadside	0	7	148	10/06/06
Edinburgh St Leonards	0	19	146	10/06/06
Aberdeen	0	14	140	01/07/06
Manchester Piccadilly	0	14	136	02/07/06
Glazebury	0	13	136	19/07/06
Lerwick	0	7	132	12/06/06
Glasgow Centre	0	5	132	10/06/06
Sheffield Centre	0	5	128	17/07/06
Plymouth Centre	0	7	126	01/07/06
London Marylebone Road	0	1	116	01/07/06
London Southwark	0	0	0	01/06/06

The 3rd Daughter Directive (Directive 2002/3/EC) on ozone in ambient air established an alert threshold of 240 μgm^{-3} as an hourly average over three consecutive hours. As shown in figure 4.3, this alert threshold was exceeded at Wicken Fen on 19th July. Eight consecutive hours were measured above 240 μgm^{-3}.

4.1.1 Historical AURN Ozone maxima

Compared to hourly measurements made since 1973, the peak ozone levels measured at the AURN network during June and July 2006 are very close to the 2003 heat wave maximum and amongst the highest seen over the last 15 years. Table 4.2 summarises ozone hourly maximum data across the AURN since 1973.

Table 4.2. Maximum Ozone Hour mean across the AURN since 1973					
Year	Site	Country	Site typet	Hourly Max µg m-3	Data Capture
1973	Central London	England	URBAN BACKGROUND	272	95.5
1974	Central London	England	URBAN BACKGROUND	328	90.8
1975	Central London	England	URBAN BACKGROUND	184	88.9
1976	Central London	England	URBAN BACKGROUND	288	78.1
1977	London Islington	England	URBAN BACKGROUND	254	87.8
1978	Central London	England	URBAN BACKGROUND	298	81.6
1979	Stevenage	England	SUBURBAN	216	86.2
1980	Stevenage	England	SUBURBAN	168	90.6
1981	Sibton	England	REMOTE	414	78.1
1982	Stevenage	England	SUBURBAN	328	81.1
1983	Stevenage	England	SUBURBAN	336	76.2
1984	Stevenage	England	SUBURBAN	348	95.6
1985	Central London	England	URBAN BACKGROUND	298	87.2
1986	Harwell	England	RURAL	274	92.7
1987	Harwell	England	RURAL	214	82
1988	Yarner Wood	England	RURAL	218	94.7
1989	Lullington Heath	England	RURAL	272	95.7
1990	Lullington Heath	England	RURAL	322	89.8
1991	Yarner Wood	England	RURAL	252	98.4
1992	Great Dun Fell	England	REMOTE	282	98.4
1993	Stevenage	England	SUBURBAN	266	98.2
1994	Sibton	England	REMOTE	254	95.6
1995	Lullington Heath	England	RURAL	268	95.5
1996	Sibton	England	REMOTE	242	92.7
1997	Leamington Spa	England	URBAN BACKGROUND	232	95.8
1998	Rochester	England	RURAL	240	93.3
1999	Barnsley Gawber	England	URBAN BACKGROUND	248	95.6
2000	Barnsley Gawber	England	URBAN BACKGROUND	206	96.5
2001	Birmingham East	England	URBAN BACKGROUND	214	97.9
2002	Sibton	England	REMOTE	218	99.1
2003	Middlesbrough	England	URBAN INDUSTRIAL	280	94.9
2004	Sibton	England	REMOTE	212	96.3
2005	Portsmouth	England	URBAN BACKGROUND	204	99.2
2006	*Wicken Fen*	*England*	*RURAL*	*278*	*99.3*

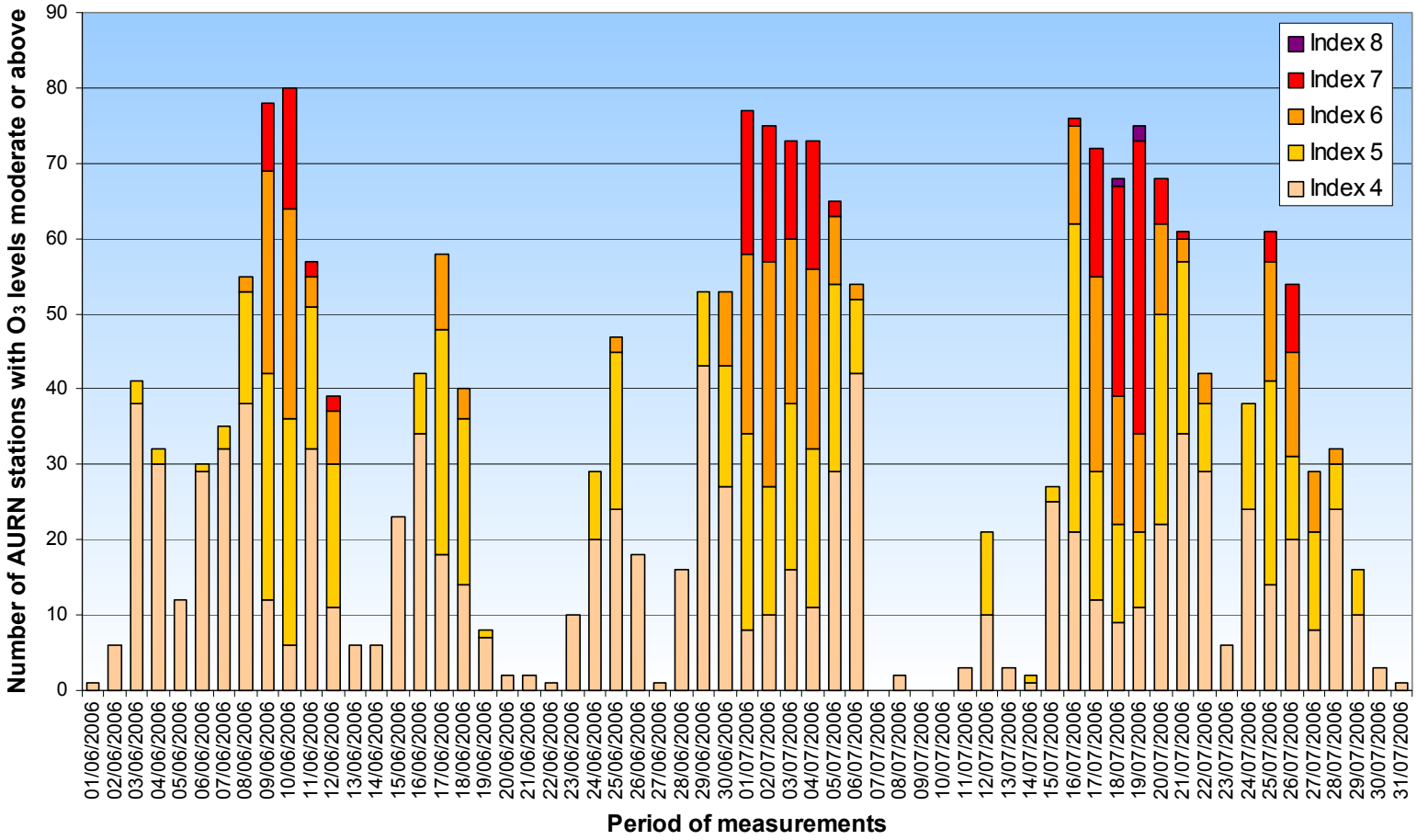


Figure 4.1. Ozone Episode Days – Number of AURN stations with MODERATE and HIGH levels between June and July 2006.

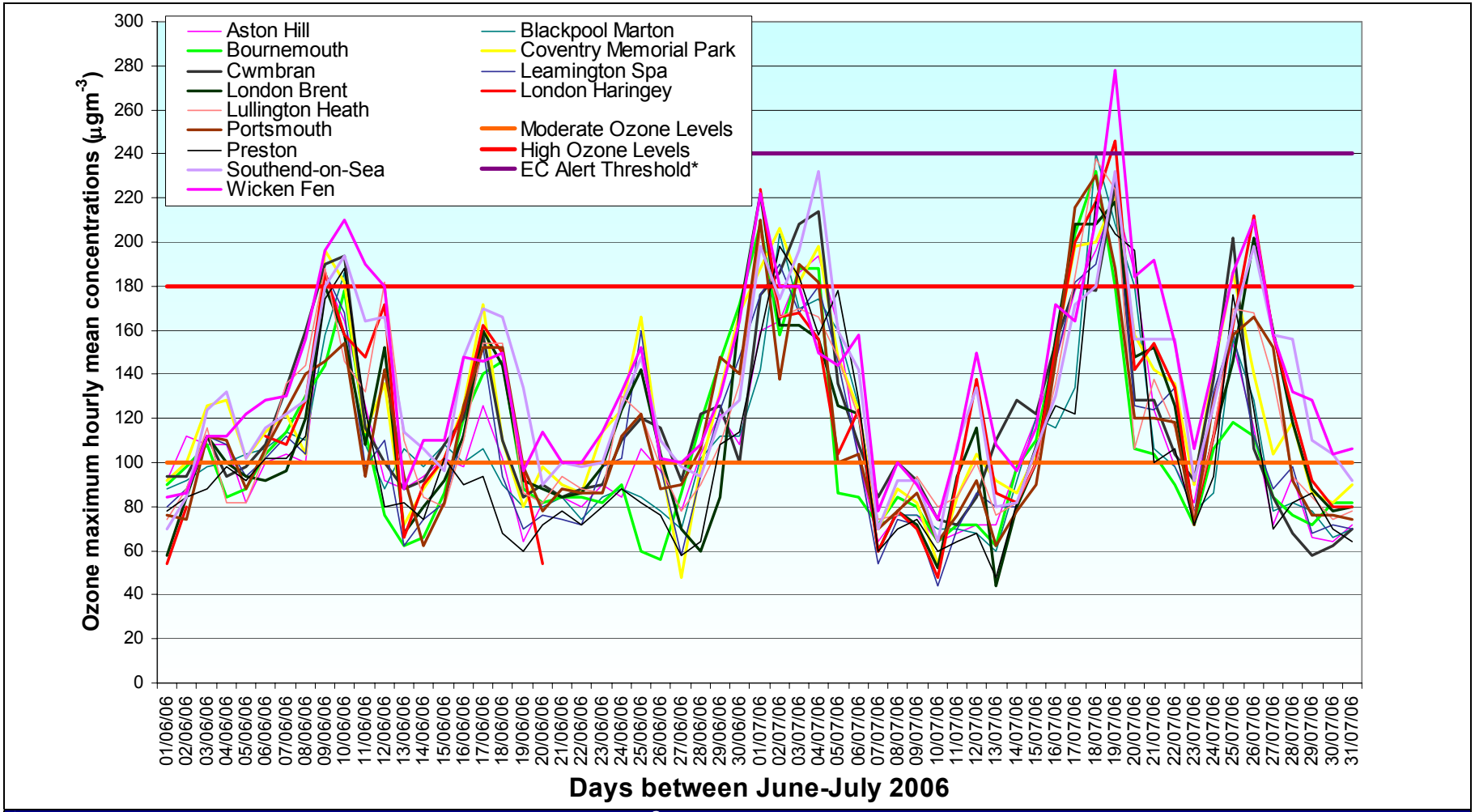


Figure 4.2. Ozone maximum hourly mean concentration (µgm^{-3}) over June and July for some AURN stations measuring elevated levels.

** The 3rd Daughter Directive (Directive 2002/3/EC) on ozone in ambient air established an alert threshold of 240 µgm^{-3} as an hourly average over three consecutive hours*

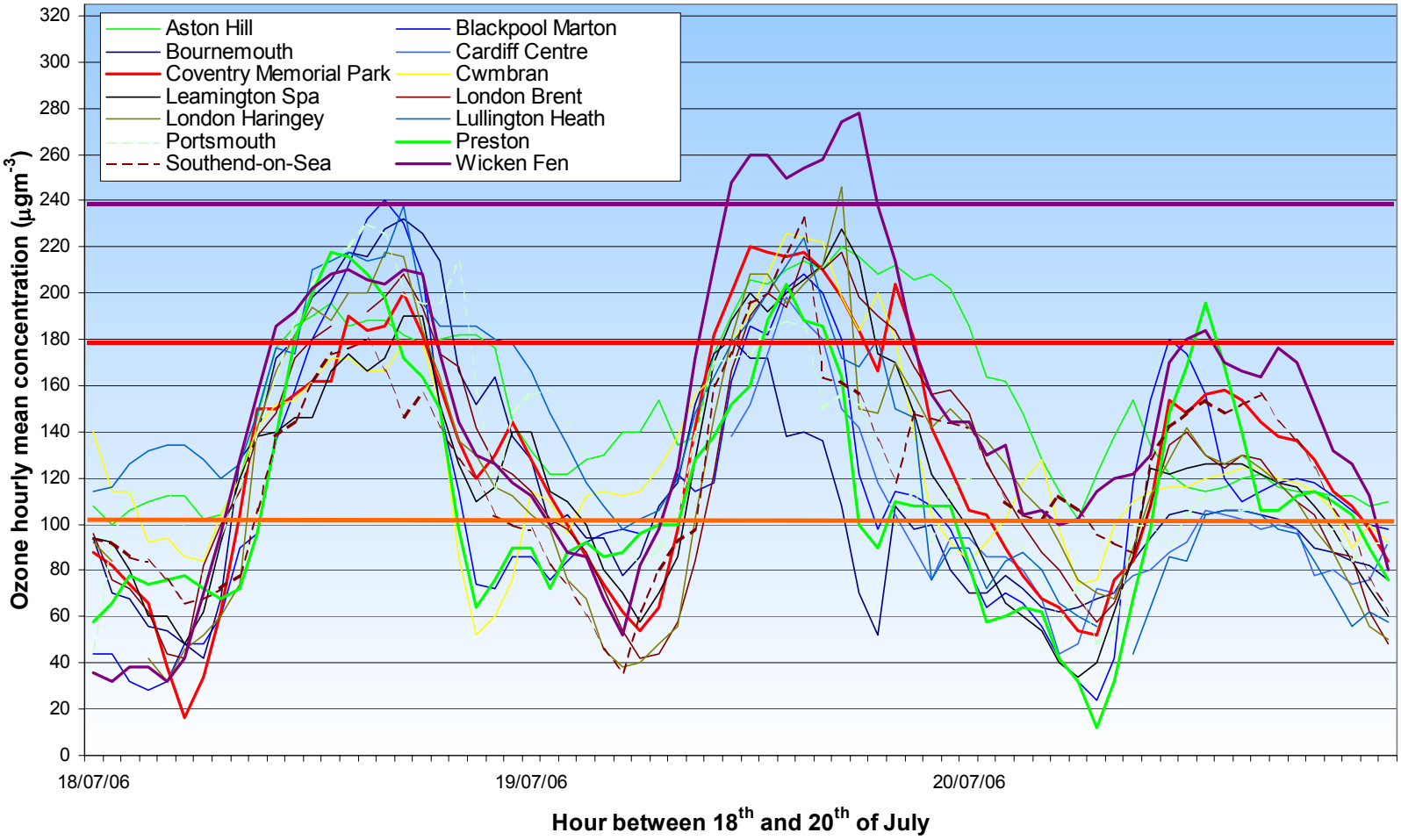


Figure 4.3. Ozone hourly mean concentration (µgm^{-3}) between 18th – 20th July for some AURN stations measuring elevated levels.

4.2 LOCAL NETWORKS

In addition to data from the AURN, measurements from a range of local air monitoring networks have been analysed in this report. These include:

- Herts & Beds Air Pollution Monitoring Network (HBAPMN) www.hertsbedsair.org.uk
- London Air Quality Network (LAQN) www.londonair.org.uk
- Kent Air Quality Monitoring Network (KAQMN) www.kentair.org.uk
- Sussex Air www.sussex-air.net

Figure 4.4 shows the number of local network stations that measured moderate and high ozone levels during June and July. The highest hourly ozone concentration measured was 251 μgm^{-3} at Lodsworth (Sussex Air) on 18th July.

The 3rd Daughter Directive (Directive 2002/3/EC) alert threshold of 240 μgm^{-3} was exceeded at this location on 18th July. Three consecutive hours were measured above 240 μgm^{-3} (see figure 4.5).

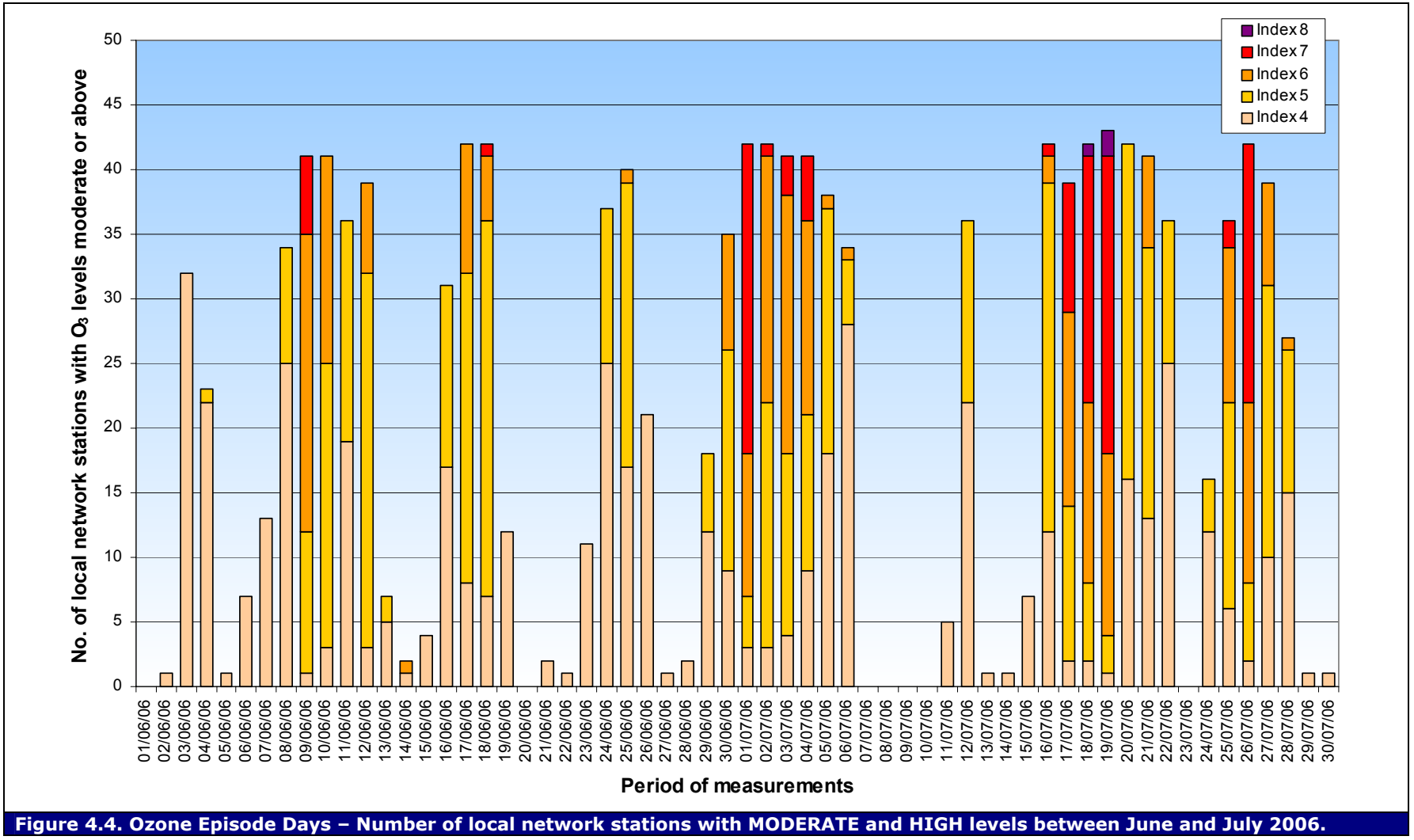


Figure 4.4. Ozone Episode Days – Number of local network stations with MODERATE and HIGH levels between June and July 2006.

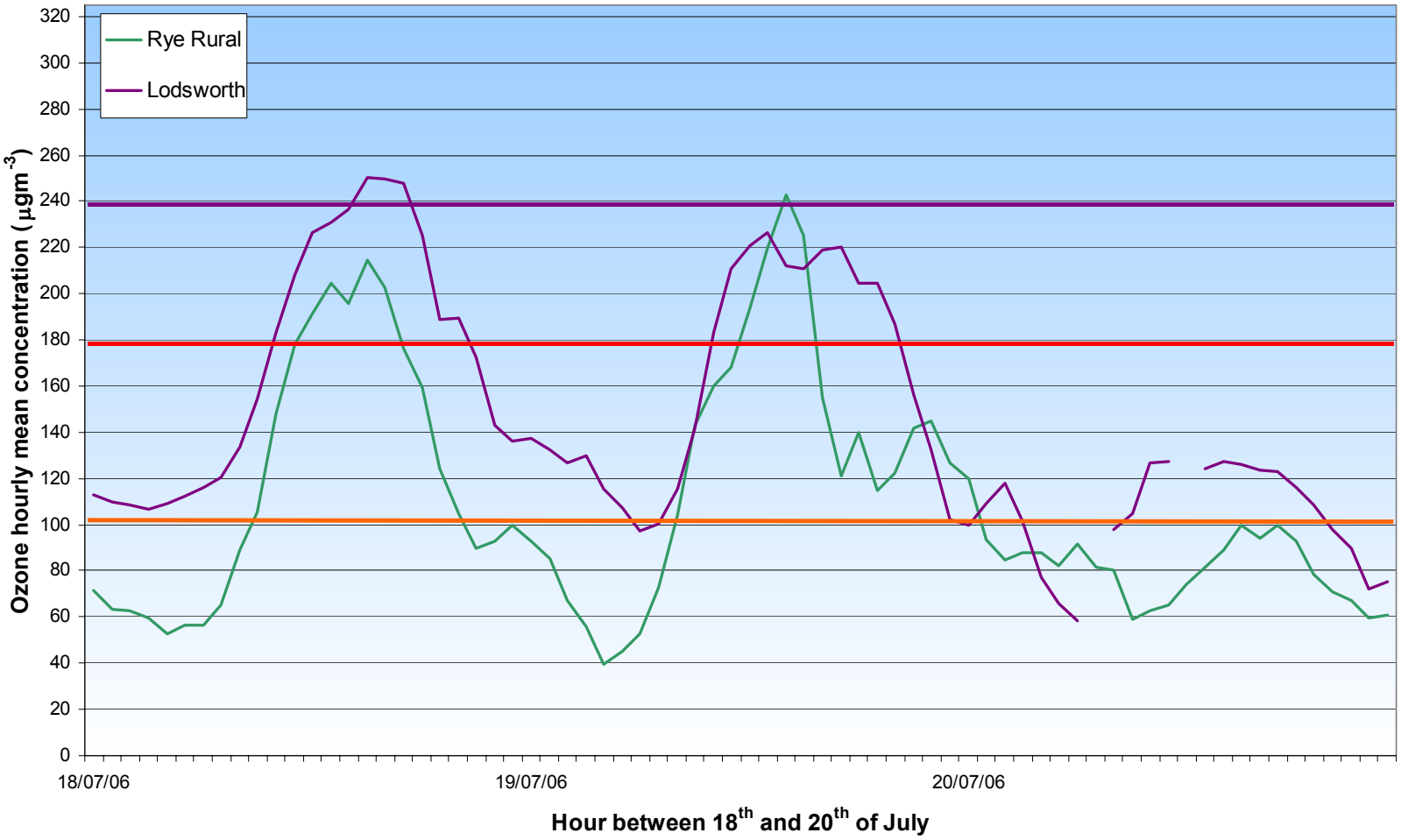


Figure 4.5. . Ozone hourly mean concentration (μgm^{-3}) between 18th – 20th July for Rye Rural and Lodsworth stations.

5 Air Quality Forecasting

Daily air quality forecasting continued as usual during June and July 2006. The two weekly air pollution forecast emails were delivered on schedule, with additional updates provided during high zone periods. Tables 5.1 to 5.6 illustrate the different air pollution forecast updates during the June and July.

Table 5.1 Air quality forecasting email on 30th June

From: Paul Willis, Netcen To: Air Quality Forecast Recipients Subject: High Air Pollution Forecast for Friday June 30th to Monday July 3rd	30/06/2006 09:26:52

Dear Colleagues,

Exceptionally hot weather continues to be forecast for the UK over the coming few days. A high pressure remains centred to the north-east of the UK and will draw easterly continental air to much of the UK as the weekend progresses.

High ozone pollution is forecast for London and south-east England later today or tomorrow, and this is expected to extend further north and west on Sunday, Monday and Tuesday. By Tuesday temperatures of 26 or 27 degrees celcius are currently forecast in Northern Ireland and for much of Scotland so it's possible that even these areas could be affected (although uncertainties in the weather this far ahead are obviously greater).

There may possibly be some thunderstorms on Sunday but otherwise dry and mainly sunny throughout.

Paul Willis
Netcen

Table 5.2 Air quality forecasting email on 4th July

From: Jaume Targa, Netcen To: Air Quality Forecast Recipients Subject: HIGH Air Pollution Forecast for Tuesday July 4th to Friday July 7th	04/07/2006 11:49:42

Dear Colleagues,

Air Pollution levels between Saturday 1st and Monday 3rd July have been characterised by HIGH levels of air pollution across England and Wales. The highest level was measured on 1st July at 18h at London Brent at 222 ugm-3. High ozone levels have been measured across 35 stations during these three days.

The weather during the next four days is likely to remain hot cooling down towards the end of the week. Today will remain hot with long sunny periods for many. Isolated thundery showers will develop across southern Britain with a few showers over Northern Ireland and western Scotland.

Wednesday will be hot (24-28 degrees) and humid with torrential thundery downpours across England and Wales. Storms pushing north into Northern Ireland and Scotland, giving the possibility of flash flooding. Further thundery downpours likely for a time on Thursday, especially across central and eastern areas of the UK. Remaining humid, but not quite as hot as recently.

Air masses approaching the UK, will originate over Europe re-circulating over the UK. HIGH ozone pollution is forecast for England and Wales for today and Wednesday. High levels of ozone may persist on Thursday if temperatures and air re-circulation remain.

Summary:
Tuesday and Wednesday
HIGH levels of air pollution across England and Wales. Moderate across Scotland and Northern Ireland

Thursday
Possible HIGH levels of air pollution across England and Wales. Moderate across Scotland and Northern Ireland

Friday
Moderate levels across England, Wales, Scotland and Northern Ireland

Jaume Targa
Netcen

Up-to-date forecasts at http://www.airquality.co.uk/
Ozone levels across Europe at http://oldlabs.eea.europa.eu/neighbourhood/ozone-web

Table 5.3 Air quality forecasting email on Tuesday 11th July

From: Gareth Leach, Netcen To: Air Quality Forecast Recipients Subject: Air Pollution Forecast for Tuesday 11th July to Friday 14th July 2006	11/07/2006 12:33:16

Dear Colleagues,

An area of high pressure to the west will slowly move towards the UK during the week. Isolated showers are forecast for Scotland and Northern Ireland for the next 2 days with all other areas experiencing dry conditions with sunny periods. All areas are expected to have dry and sunny periods by the end of the week. Daytime maximum temperatures are forecast to be 26 degrees C in the south of England and Wales, with slightly cooler temperatures elsewhere.

Air mass back trajectories indicate clean Atlantic air reaching the UK initially from a westerly direction. As the high pressure centres over the UK the westerly air will pass over the North sea before reaching East Anglia and the south east of England from an easterly direction.

Air pollution levels are forecast to be MODERATE at index 5 or 6 due to ground level ozone in London, the Midlands, southern England and Wales, with MODERATE levels at index 4 expected in other areas.

The site at Port Talbot may measure MODERATE levels of PM10 under the present conditions due to the localised activities.

All other pollutants are expected to remain in the LOW band.

Gareth Leach
Netcen

Table 5.4 Air quality forecasting email on 17th July

From: Andy Cook, Netcen To: Air Quality Forecast Recipients Subject: HIGH Air Pollution Forecast for Monday 17th to Wednesday 19th July 2006	17/07/2006 10:42:01

Dear Colleagues,

Maximum daytime temperatures will be around 30 degrees C today in England and becoming warmer on subsequent days up to Wednesday, rising to 35 C in the south-east of England on Wednesday with the rest of England in the low 30s and Scotland and Northern Ireland reaching daily maxima of 28 or 29 C. Air mass back-trajectory plots show that air arriving in England and Wales over the next 3 days will be sourced from Europe, while Scotland and Northern Ireland will predominantly experience cleaner Atlantic air from the north. A light to moderate breeze and clear skies are forecast throughout until Wednesday, after which light cloud cover and slightly cooler temperatures are expected.

Ozone levels are therefore forecast to reach the HIGH band (index 7 or 8 expected) on all three days in England and Wales, the upper MODERATE band is expected in Scotland and Northern Ireland (index 6 typically), with the possibility of HIGH levels in Scotland if ozone has drifted upwards from the south, particularly towards the end of the 3 day period. The highest levels are expected to be measured towards the south west of England today, the Midlands and the north of England tomorrow and towards the south east of England on Wednesday.

PM10 levels may reach the MODERATE band near busy roads or industrial locations (index 4 typically) due to secondary contributions from European sources.

The situation will be kept under review and further updates issued when necessary.

Andrew Cook
Netcen

Table 5.5 Air quality forecasting email sent on Tuesday 18th July

From: Andy Cook, Netcen To: Air Quality Forecast Recipients Subject: Air Pollution Forecast for Tuesday 18th July to Friday 21st July 2006	18/07/2006 13:20:52

Dear Colleagues,

High Air Quality Forecast

Today's air quality forecast is for HIGH ozone (index 7 expected) in all regions of England and Wales, with Scotland and Northern Ireland staying within the MODERATE band. HIGH pollution levels due to ozone are forecast tomorrow in all UK regions, with the possibility of some regions reaching index 8.

On Thursday, HIGH ozone levels are possible for central and north-east England and East Anglia (index 7), staying MODERATE in other areas (index 4 - 6). Isolated HIGH levels may also persist in East Anglia and the East Midlands on Friday, but with the majority of areas remaining within the MODERATE band (index 4 - 6).

Particulate PM10 levels may reach the MODERATE band near busy roads or industrial locations (index 4 typically) due to secondary contributions from European sources over the next two days.

The situation will be kept under review and further updates issued when necessary.

Background to the Forecast

High temperatures and the influence of continental air masses provide the basic background conditions to this forecast.The elevated temperatures, combined with easterly or south-easterly air trajectories over the next 2 days, will be particularly conducive to photochemical ground-level ozone formation.

Light cloud may be experienced in the north of Scotland over the next two days but, otherwise, clear skies will persist over the whole of the UK. Daytime temperatures will be very warm today: above 30 degrees C in England, Wales and central Scotland, up to 33 C in the Midlands and around 25 C in Northern Ireland. Wednesday is forecast to be warmer still; 30 C in Northern Ireland and the north of England, around 35 C in
East Anglia, central England and central Scotland, 32 C in the south of England, cooler in the south west and up to a UK maximum of 37 C in the south east of England.

Thursday's conditions will be cooler, with the effects of low pressure air over the Atlantic to the north-west being gradually experienced, bringing light cloud to many areas. Daytime temperatures will remain warm at 29 C in central England and East Anglia, the mid 20s C in many other areas, cooler still in the south-west and north of England. By Friday, cloudier conditions are expected in all areas; this will lead to further cooling to 27 C in the south east of England, with the majority of England and Northern Ireland around 25 C. Western coasts and the north of Scotland are expected to be cooler still.

Throughout this week, light to moderate breezes will be prevalent. Air mass back-trajectory plots show that air reaching all UK regions over the next 24 hours will originate from continental Europe; after this period,
air will increasingly originate from the Atlantic to the west. By Thursday, only a small component of the air reaching the UK will have originated from Europe; by Friday, air will be exclusively from the west.

Andrew Cook
NETCEN

Table 5.6 Air quality forecasting email sent on Friday 21st July

From: Andy Cook, Netcen To: Air Quality Forecast Recipients Subject: Air Pollution Forecast for Friday 21st July to Monday 24th July 2006	21/07/2006 13:12:39

Dear Colleagues,

High pressure air will remain around for at least the next week. Currently high pressure, centred to the south of the UK, is causing air to reach the UK from a south-westerly direction. Some of this air may have passed over from continental Europe on route. Over the course of this weekend the incoming air will become cleaner, i.e. with a lessening component of the air contributed from Europe.

Light cloud and sunny spells today will see the south-east of England at 32 degrees C, other areas of England in the high 20s, cooler in Wales, Scotland and Northern Ireland (20 to 25 C). On Saturday a band of thundery showers will pass over northwards, otherwise light cloud will persist. Daily maxima of 28 C and 27 C for example, are forecast for the south-east and Midlands respectively. Sunday will see unbroken sunshine over the south of England, light cloud in other areas, showers spreading in to Scotland and Northern Ireland. 28 C is forecast for the south of England, other parts of England will be in the high 20s, below 25 C in all other areas. Monday will see a return to wider spread clear and sunny conditions, up to 30 C in the south of England. Wind speeds will be light to moderate throughout this period.

HIGH ozone band concentrations remain a possibility on all days and are most likely to be experienced in England and Wales, although not expected to be high in number. As the weekend progresses HIGH levels become increasingly less likely as the incoming air is sampled from a cleaner, south-westerly direction. Ozone models predict that highest levels will be seen towards eastern areas of England, with wider spread elevated levels on Saturday.

Therefore the forecast is for HIGH (index 7) ozone in England and Wales on Friday and Saturday and HIGH (index 7) on Sunday in the south and south-east of England, East Midlands and East Anglia. Particulate PM10 levels in the MODERATE band (index 4 to 6) near busy roads and industrial locations are expected to persist but the levels measured are likely to fall slightly over the course of the weekend. Other pollutants are expected to remain in the LOW band (index 1 -3).

A summary of levels of ozone see since Monday 17th July is given below:

HIGH levels were seen on Monday 17th at eighteen AQM sites in the AURN network. On Tuesday 18th, twenty eight sites reached the HIGH band, one of which was Blackpool Marton in the north west zone which reached 240 ug/m3 (index 8) at 5 pm. On Wednesday 19th July 41 geographically widespread AURN sites measured in the HIGH band, two of which reached index 8. Cwmbran in South Wales measured 3 hourly averages in the index 8 band (maximum hourly average was 246 ug/m3) and Wicken Fen in East Anglia measured 10 consecutive hours at index 8 (maximum hourly average 276 ug/m3). Only 9 of the sites reaching the HIGH band were non-urban designated on Wednesday. On Thursday 20th 6 sites entered the HIGH band at index 7, one situated in Wales, the other 5 located in England.

Andrew Cook
NETCEN

6 Reasons for this ozone episodes

As reported by Targa (2004 and 2005) and Kent (2003), summer ozone episode over the UK are usually characterised by high temperatures and air masses re-circulating over northern Europe and the UK. These conditions typically result in summer smog episodes as the ozone precursor chemicals react in the presence of sunlight.

The June and July 2006 ozone episodes are characterised by these two factors. It is important that both high temperatures and re-circulation of air masses are coupled together to result in a summer smog episode.

6.1 TEMPERATURE

As discussed in section 3, temperatures across June and, especially, July were exceptionally high. A temperature of 36.5°C was measured on 19th July, setting a new UK July temperature record. As can be seen in figures 6.1 and 6.2, the days when high ozone levels have been measured mostly coincide with periods with elevated temperatures.

The third ozone episode, which measured the highest ozone levels in 2006, also corresponded with the highest temperatures recorded.

6.2 RE-CIRCULATION OF AIR MASSES

Despite the good agreement between high temperature and high ozone shown in figure 6.1, the re-circulation of air masses over Europe and the UK need also to coincide. As discussed in Targa (2006), if high temperatures are not associated with air masses re-circulation, then the conditions do not always necessarily lead to high ozone levels. On the other hand, if periods characterised by re-circulation of air masses do not coincide with high temperatures, ozone levels often remain moderate.

To assist daily air quality forecasting in the UK, *1000mB 96-hour Forecast Air Back-Trajectories* are produced and used on a daily basis within Netcen. Airmass Trajectories are simple linear representations of large-scale air movements in the atmosphere. Although they are relatively easy to understand and to visualise, they do not take into account the effects of turbulent mixing and therefore do not show the full range of air movements possible. Back-trajectories show how air masses may have been transported prior to reaching their destination, whereas forward-trajectories show the movement of air after leaving its origin.

Figures 6.3-6.5 show the 96-hour airmass back-trajectories for the three episodes identified. The re-circulation of air masses over Europe are specially important during those days when high ozone levels were measured. Appendix A includes all the air mass back-trajectories over the period June-July 2006.

Figure 6.5a shows the re-circulation of air masses over Europe on the 19th July. This, coupled with the July's record temperatures, resulted in high ozone levels measured at no less than 41 AURN stations.

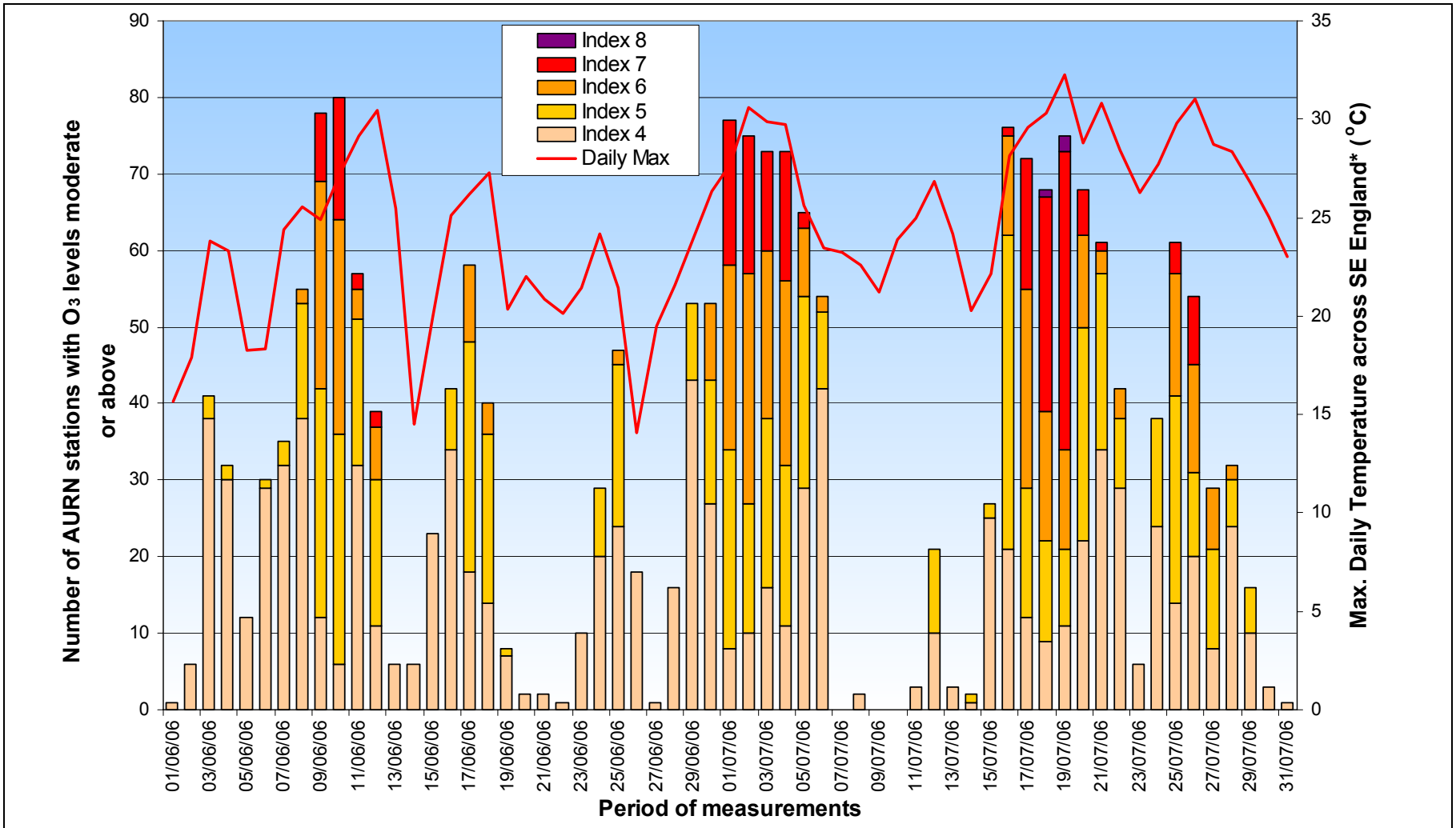


Figure 6.1. Number of Stations with MODERATE and HIGH levels during June and July 2006 with temperature profile across the South East.
Provisional Temperature data from Kent Air Quality Monitoring Network (KAQMN)

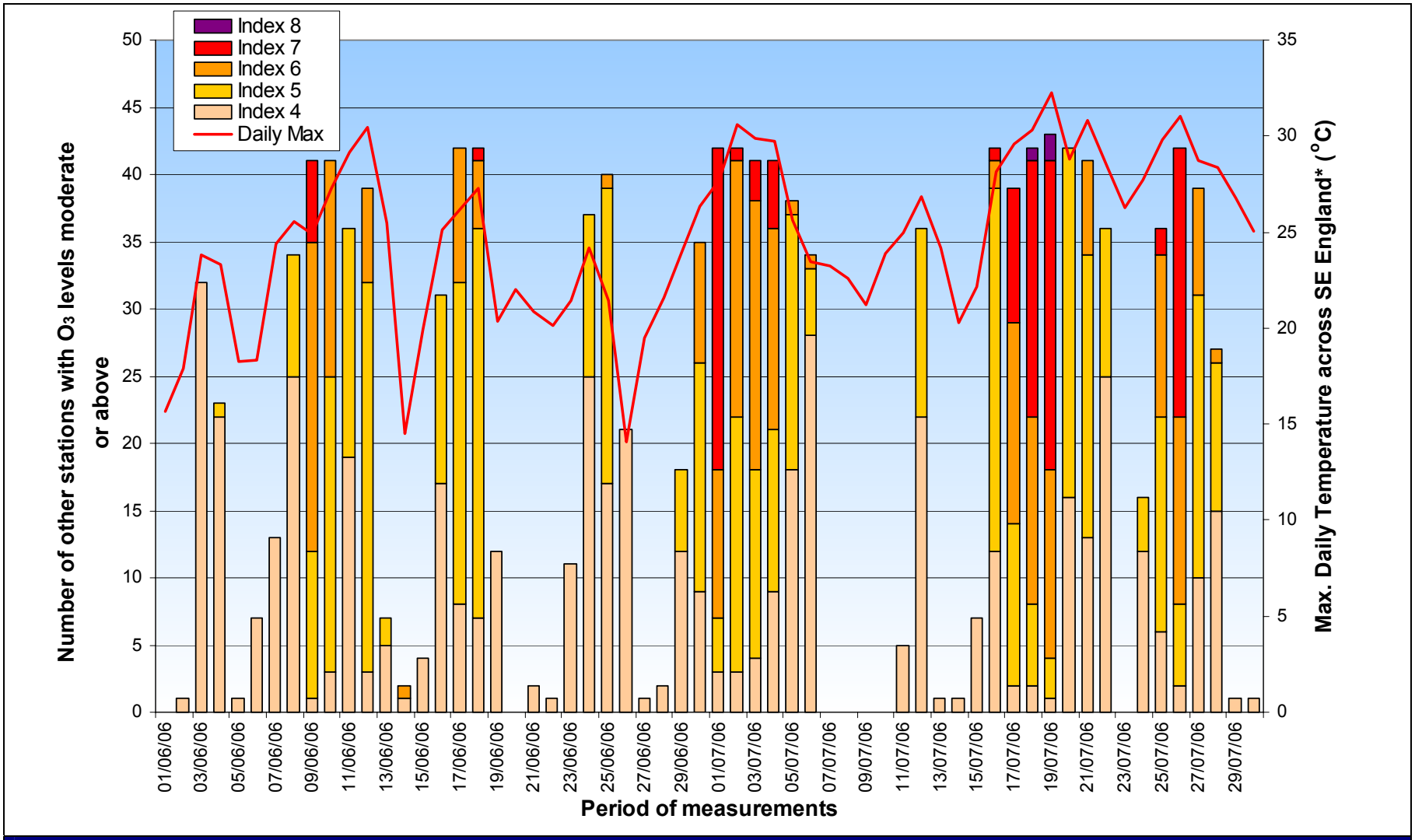
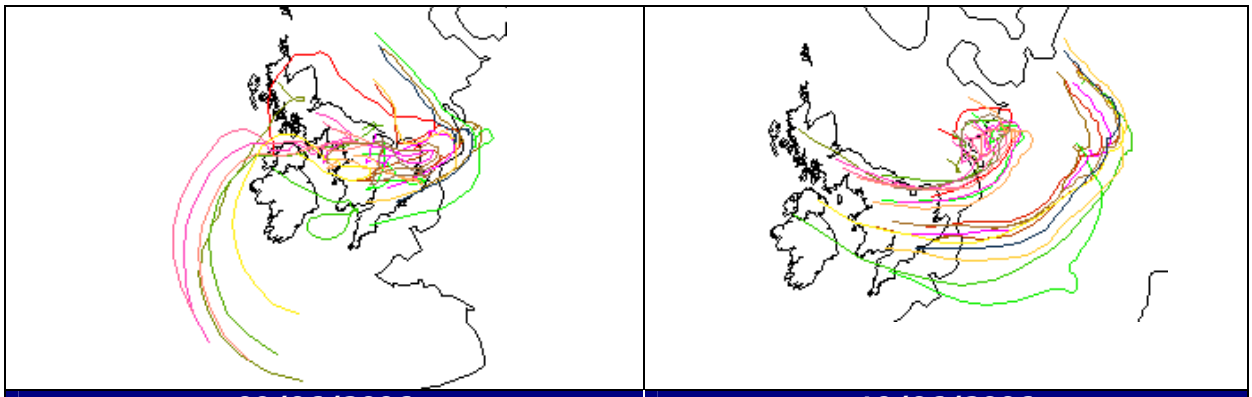
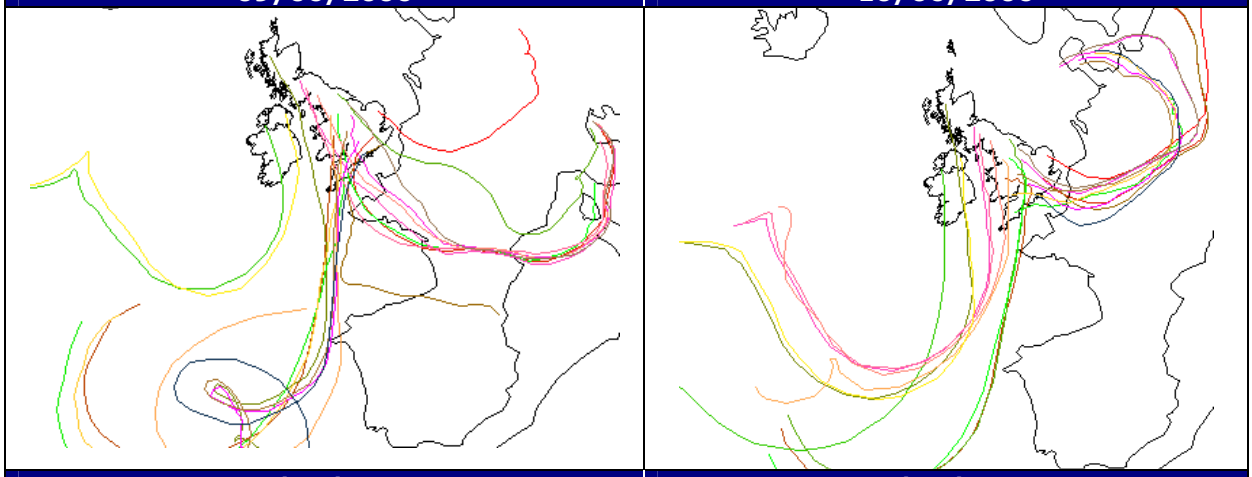


Figure 6.2. Number of Stations with MODERATE and HIGH levels during June and July 2006 with temperature profile across the South East.
Provisional Temperature data from Kent Air Quality Monitoring Network (KAQMN)



09/06/2006 | 10/06/2006



11/06/2006 | 12/06/2006

Figure 6.3- 96 hours airmass backtrajectories during first episode (9th-12th Jun)

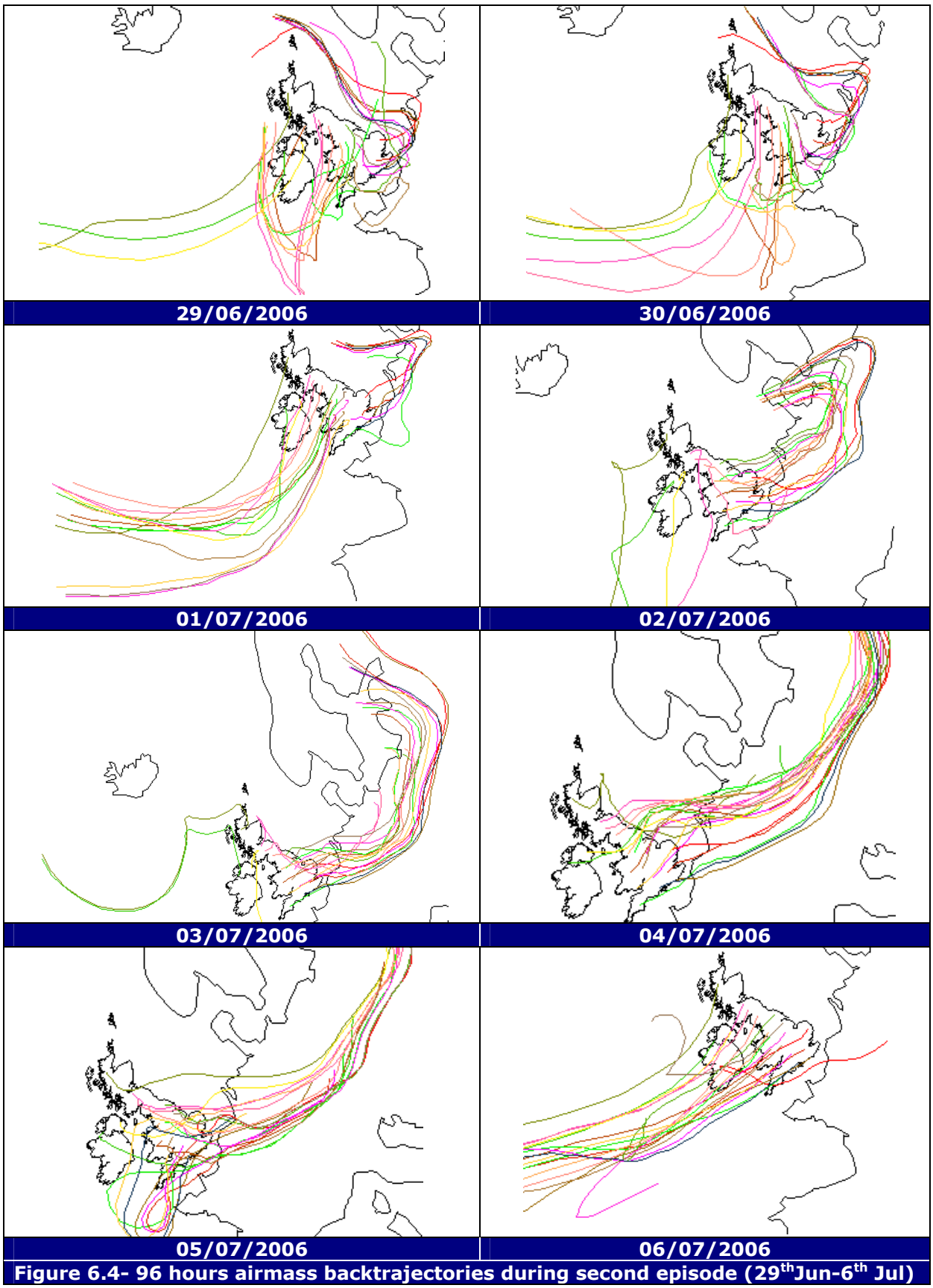


Figure 6.4- 96 hours airmass backtrajectories during second episode (29th Jun-6th Jul)

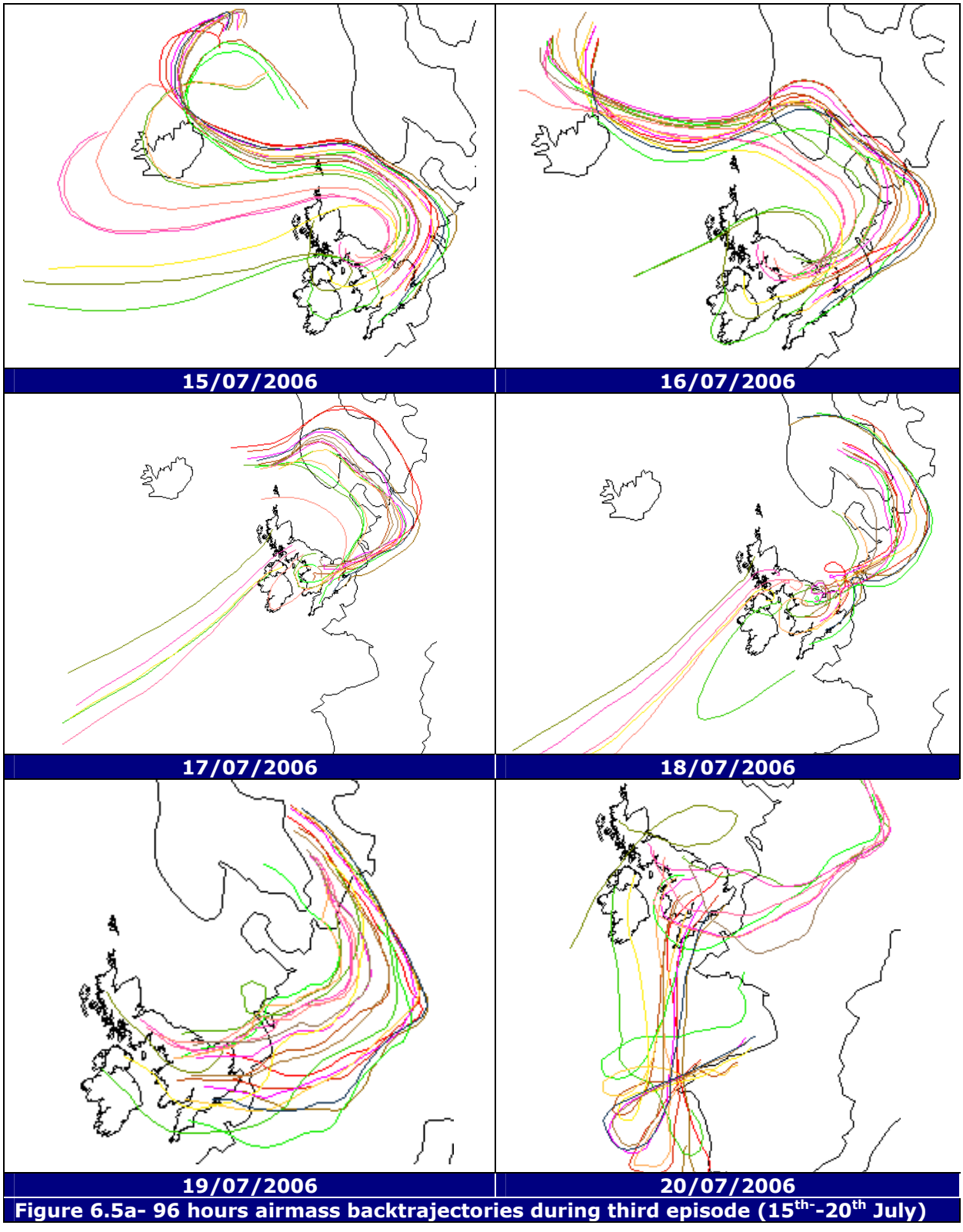


Figure 6.5a- 96 hours airmass backtrajectories during third episode (15th-20th July)

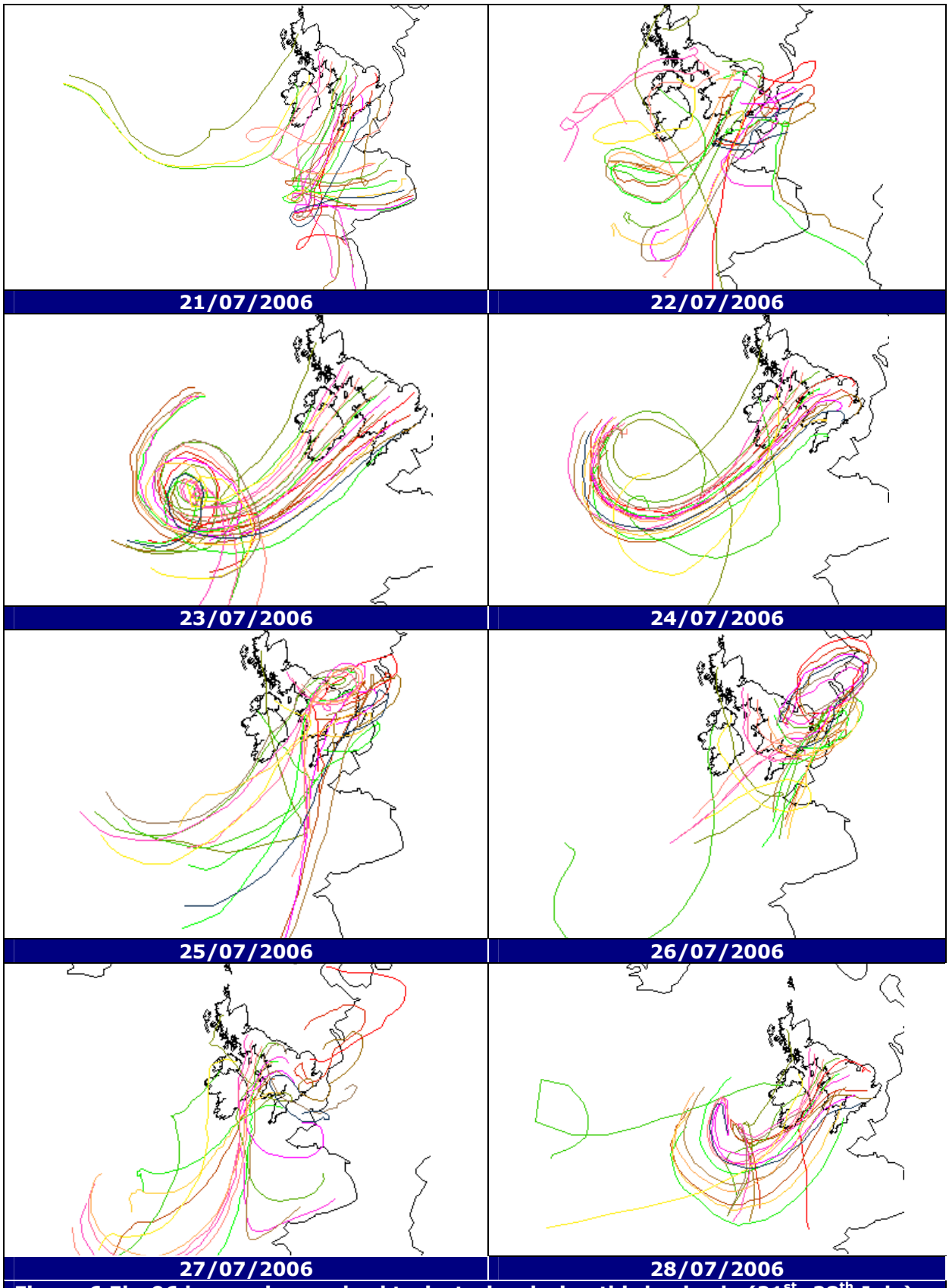


Figure 6.5b- 96 hours airmass backtrajectories during third episode (21st -28th July)

7 Ozone Episode across Europe

The high temperatures across England and Wales also occurred across Europe. The 2006 European heat wave arrived at the end of June in a number of European countries including the UK, Ireland, France, Belgium, the Netherlands, Luxemburg, Poland, the Czech Republic and Germany. In some countries, July 2006 was the warmest month since official measurements began. The highest temperatures were generally recorded on 19th July.

As can be seen in figure 7.1, temperatures in Europe were as hot or hotter than in the UK. This European heat wave resulted in a widespread ozone episode across the UK and continental Europe. Figures 7.2 to 7.4 show three examples of the ozone episodes across Northern Europe in July 2006. Please see appendix B for hour-to-hour episode development of important days during July.

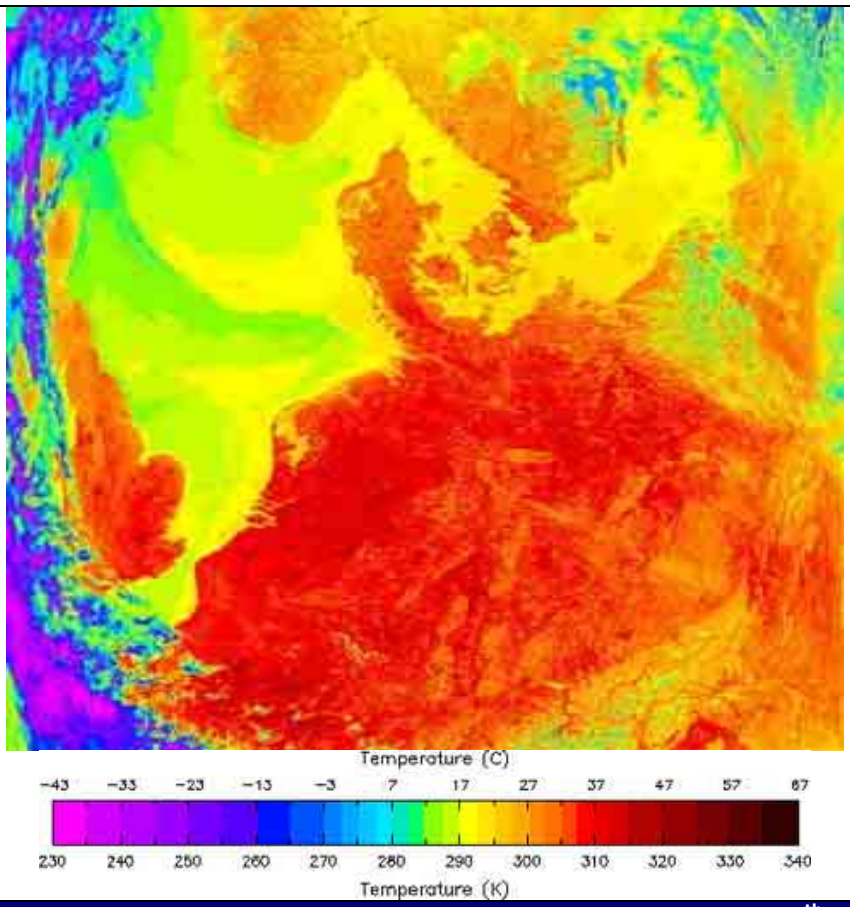
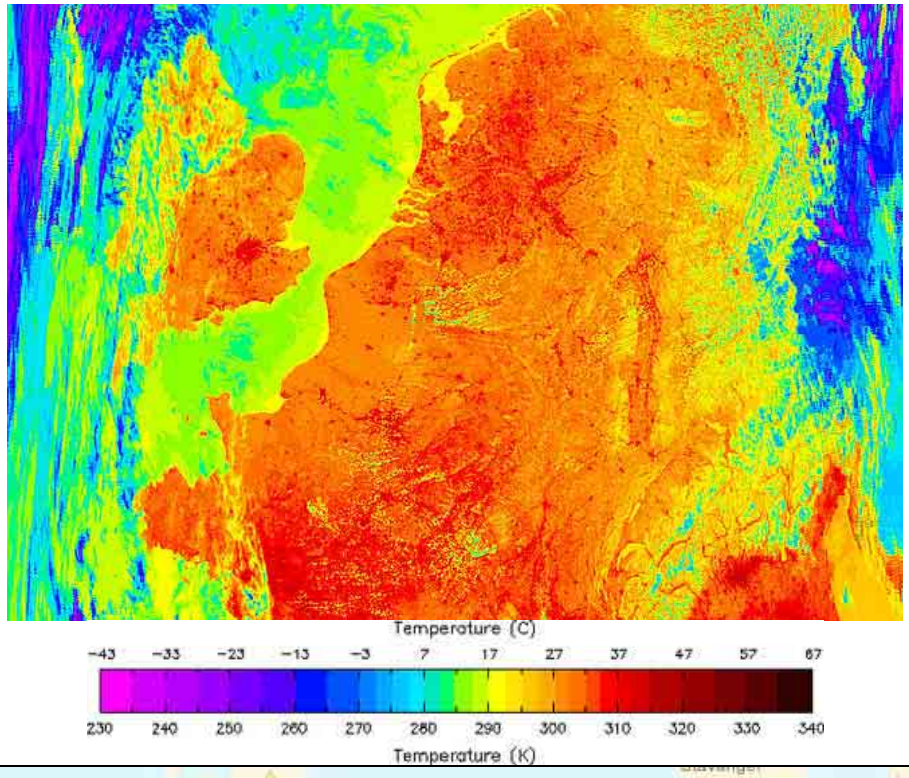


Figure 7.1 – Modis Satellite Image showing Temperature on 19th July 2006 at 10:35 UTC

Figure 7.2 shows a false-colour satellite image showing surface temperatures and spread of the ozone episode on 1st July over Northern Europe. Apart from the UK, major impacts were measured in Belgium and some elevated measurements were also observed in France.



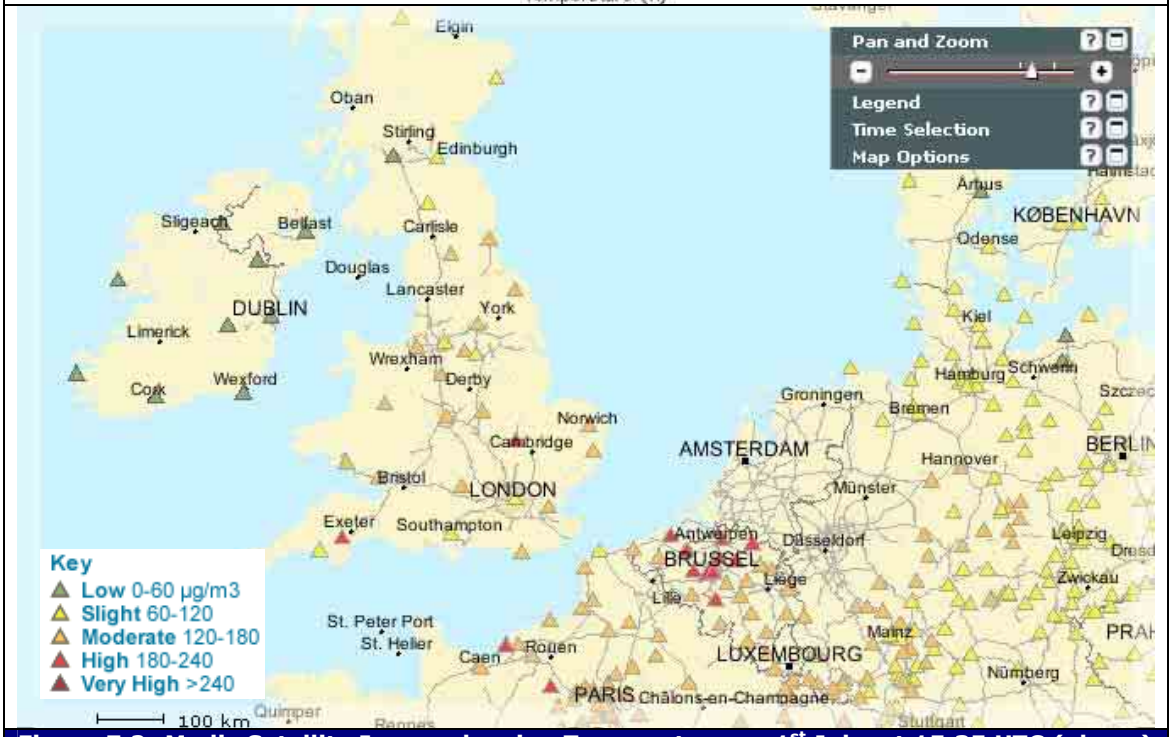


Figure 7.2- Modis Satellite Image showing Temperature on 1st July at 15:35 UTC (above) and Ozone levels across Northern Europe from EEA's Ozone Web (*provisional data*) (below)

Figure 7.3 overleaf illustrates the ozone episode on the 5th July at 14:00. Despite this episode being relatively weak in the UK, high levels of ozone were measured over Northern Europe , and in particular in Germany and the Netherlands.

Figure 7.3- Ozone Episode across Northern Europe not measured in the UK on 5th July at 14:00 from EEA's Ozone Web (*provisional data*)

Figure 7.4 shows the ozone episode on the 19th July. During this period, high temperatures were measured over Northern Europe (see figure 7.1). Apart from the UK, high ozone levels were also measured in Ireland, France, Belgium, the Netherlands, Luxembourg, Germany and Czech Republic.

Figure 7.4- Ozone Episode across Northern Europe on 19th July at 16:00 from EEA's Ozone Web (*provisional data*)

8 Other pollutants measured during the heat wave of 2006

During the 2006 heat wave, levels of a wide range of other pollutants apart from ozone were also measured across the AURN. Despite the lack of a widespread PM_{10} or SO_2 episode, some interesting observations were made. In particular, elevated SO_2 levels were seen in July in London and southeast England.

Table 8.1 and 8.2 provide a useful summary of the number of days and maximum concentrations measured across the AURN for PM_{10} and SO_2 respectively. As can be seen, elevated levels of PM_{10} and SO_2 were not as widespread as the corresponding elevated ozone levels shown in table 4.1.

Apart from two industrial sites (Scunthorpe Town and Port Talbot) and three busy roadsides (London Marylebone Road, Camden Kerbside, Glasgow Kerbside) PM_{10} levels were typically slightly elevated.

Table 8.1. Number days of Moderate and High levels due to PM_{10} at some stations across the AURN between June and July 2006

Site	Number of Days			Max daily mean (μgm^{-3}) *(grav equival) provisional*	Date of hourly max concentration
	Very High	High	Moderate		
Scunthorpe Town	1	3	11	137	10/06/06
Port Talbot	0	2	12	120	10/07/06
London Marylebone Road	0	0	17	95	21/07/06
Camden Kerbside	0	0	7	91	05/07/06
Glasgow Kerbside	0	0	4	68	21/07/06
Bradford Centre	0	0	2	81	10/06/06
Bristol St Paul's	0	0	2	82	02/07/06
Stockton-on-Tees Yarm	0	0	2	85	06/07/06
Swansea	0	0	2	83	10/06/06
Birmingham Centre	0	0	1	73	06/06/06
Bury Roadside	0	0	1	68	20/07/06
Leeds Centre	0	0	1	65	06/07/06
London Bloomsbury	0	0	1	72	05/07/06
London Eltham	0	0	1	68	05/07/06
London N. Kensington	0	0	1	66	05/07/06
Manchester Piccadilly	0	0	1	73	20/07/06
Middlesbrough	0	0	1	75	06/07/06
Southampton Centre	0	0	1	65	26/07/06

Figure 8.1 shows the daily PM_{10} measurements during June-July 2006; it highlights those sites with slightly elevated levels. Elevated PM_{10} levels seem to correspond with elevated periods of ozone. As discussed in section 6.2, those days with elevated ozone levels were associated with re-circulation of air masses over the continent. Elevated PM_{10} levels during June-July 2006 are probably due to air masses originating over Europe, increasing PM_{10} levels over in the UK.

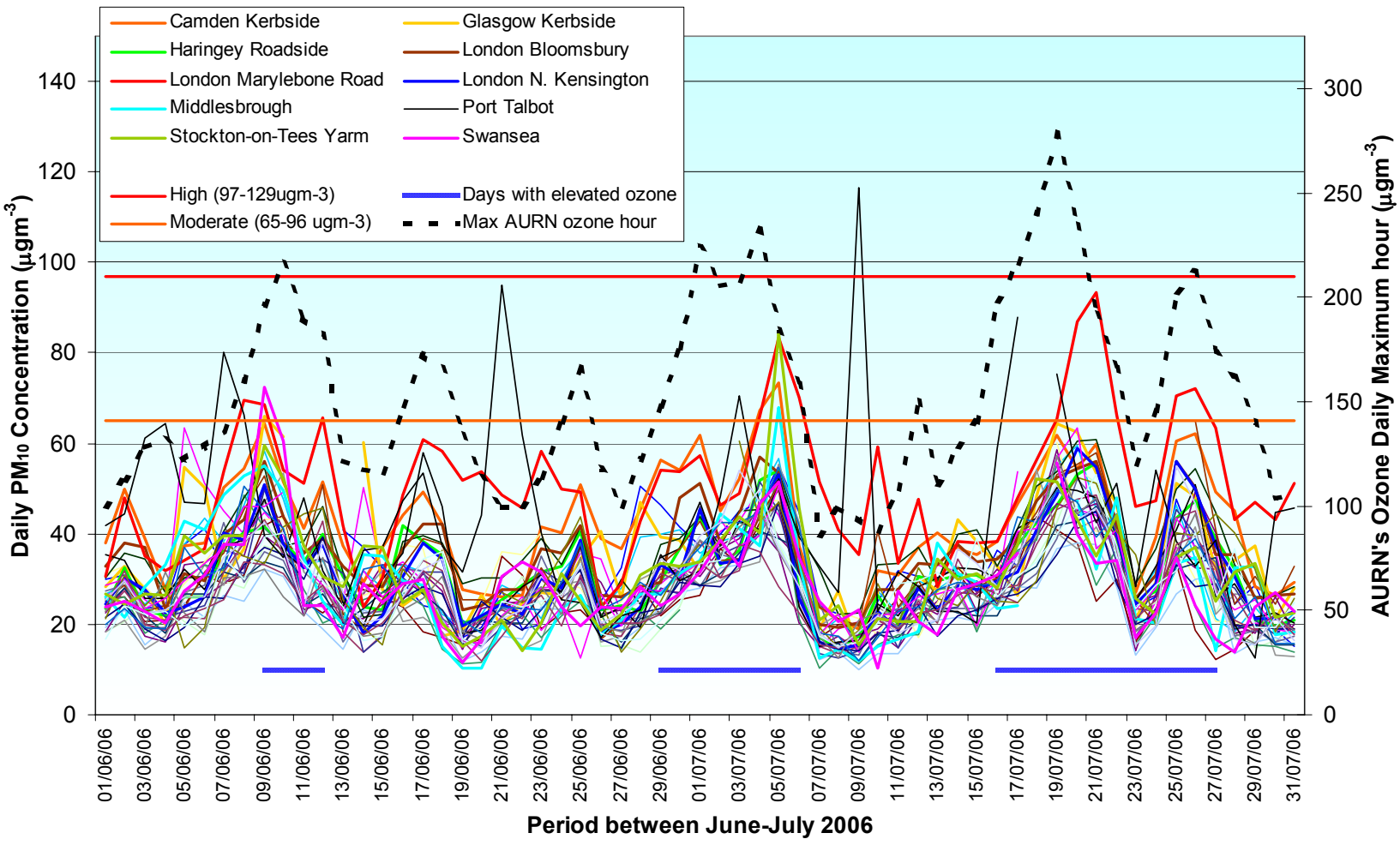


Figure 8.1. Daily PM10 concentrations during June-July 2006 alongside the ozone episodes.

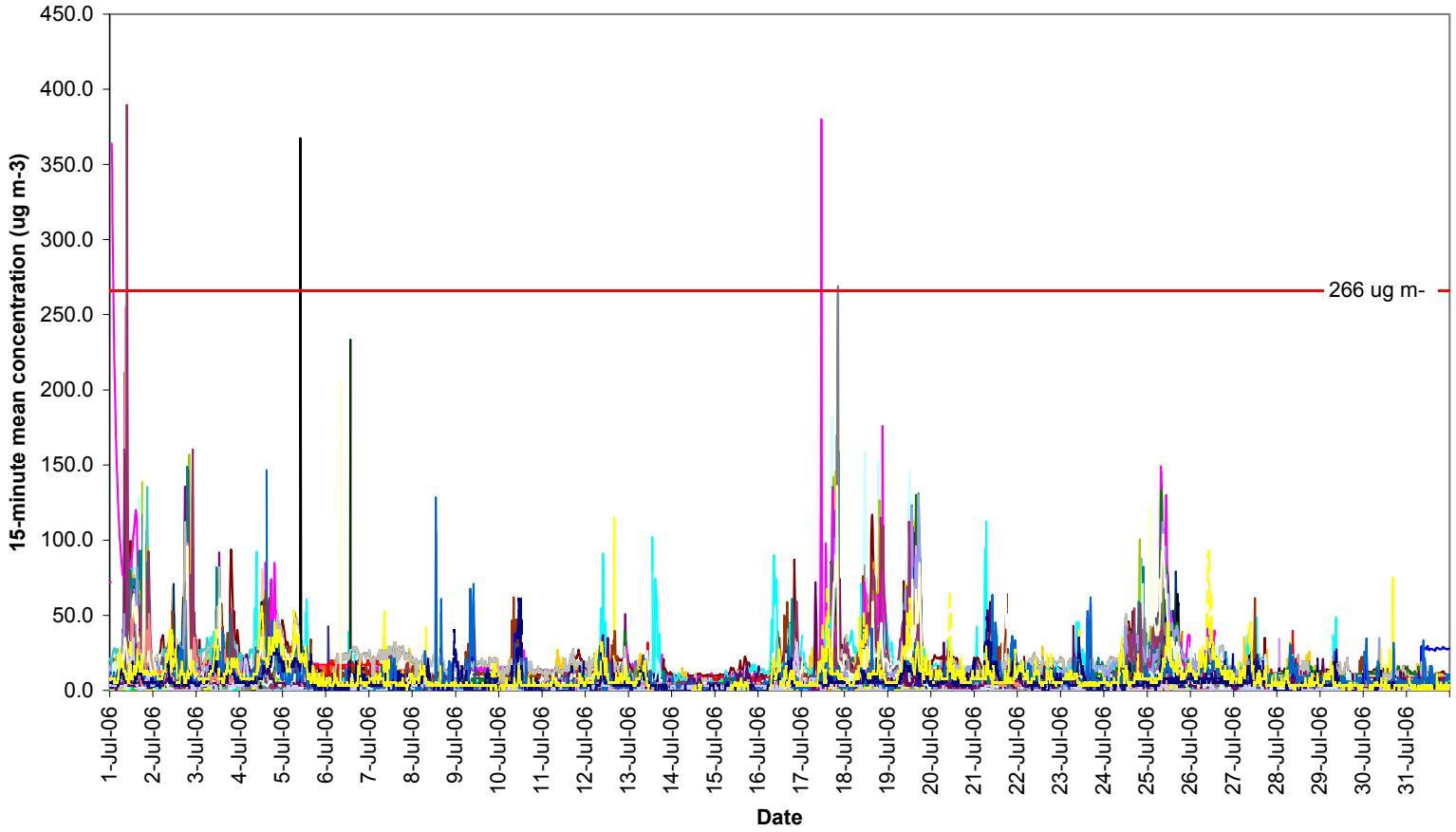


Figure 8.2 SO_2 15-minute concentrations from sites in London and South East (AURN and LAQN)

The PM_{10} spikes at Port Talbot (figure 8.1) are not unusual for this site which is closed to a large industrial complex. Elevated concentrations were measured on the 21st June and 9th July 2006. The PM_{10} pollution rose (figure 8.3) shows that elevated PM_{10} levels are typical of Southwesterly conditions indicating pollution from the steal works.

Table 8.2. Number days of Moderate and High levels due to SO_2 at some stations across the AURN and LAQN between June and July 2006

Site	Number of Days			Max 15min mean (μgm^{-3}) *provisional*	Date of hourly max concentration
	Very High	High	Moderate		
London Bexley	0	0	2	412	17/07/06
Grangemouth	0	0	1	317	14/07/06
Liverpool Speke	0	0	1	394	08/06/06
London N. Kensington	0	0	1	266	17/07/06
London Teddington	0	0	1	328	01/07/06
London Westminster	0	0	1	622	21/07/06
Salford Eccles	0	0	1	295	25/07/06

In relation to SO_2 levels, sporadic 'spikes' in concentrations were observed across London and South East England. Figure 8.2 shows the 15-minute mean concentrations across this area (includes LAQN data). Despite the majority being below 266ugm-3 threshold level, these spikes are unusual for the area and time of year. These elevated levels may be the result of increased power consumption during the heatwave, possibly coupled with meteorological conditions associated with the heatwave.

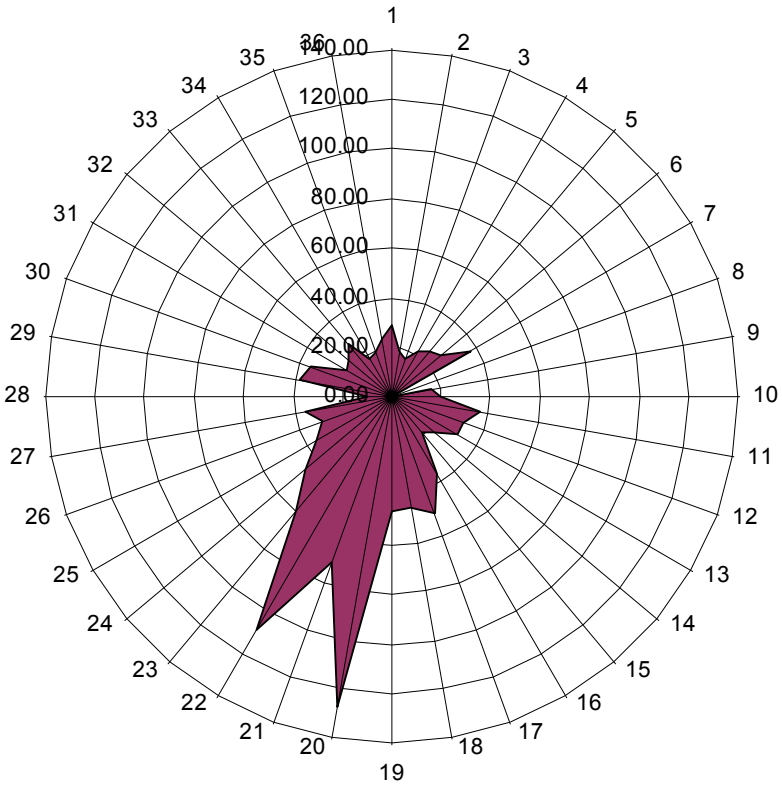


Figure 8.3- PM_{10} Pollution Rose at Port Talbot between 20th June and 10th July 2006

9 Conclusions

The main features of the June/July 2006 ozone episode may be summarised as follows:

- High summer temperatures, combined with recirculating air over Europe and the UK resulted in the first prolonged ozone episode of 2006 .
- The June/July episode was also measured across Europe in the Benelux, Germany, France, Czech Republic…
- High summer temperatures in July resulted in HIGH levels of ozone, due to re-circulation of air over Europe or the UK.
- The area affected by the June/July episode was limited to England and Wales.
- Changes in temperature and airmass back trajectories brought the episode to an end as clean air arrived from the Atlantic
- The highest hourly average ozone concentration recording during the episode was 278 μgm^{-3} (index 8) on the 19th July at Wicken Fen at 18.00.
- 3rd Daughter Directive ozone alert threshold of 240 μgm^{-3} was exceeded at Wicken Fen on 19th July, when 8 consecutive hours were measured above 240 μgm^{-3}.
- This threshold was also exceeded at a non-AURN site, Lodsworth (Sussex Air) on 18th July.

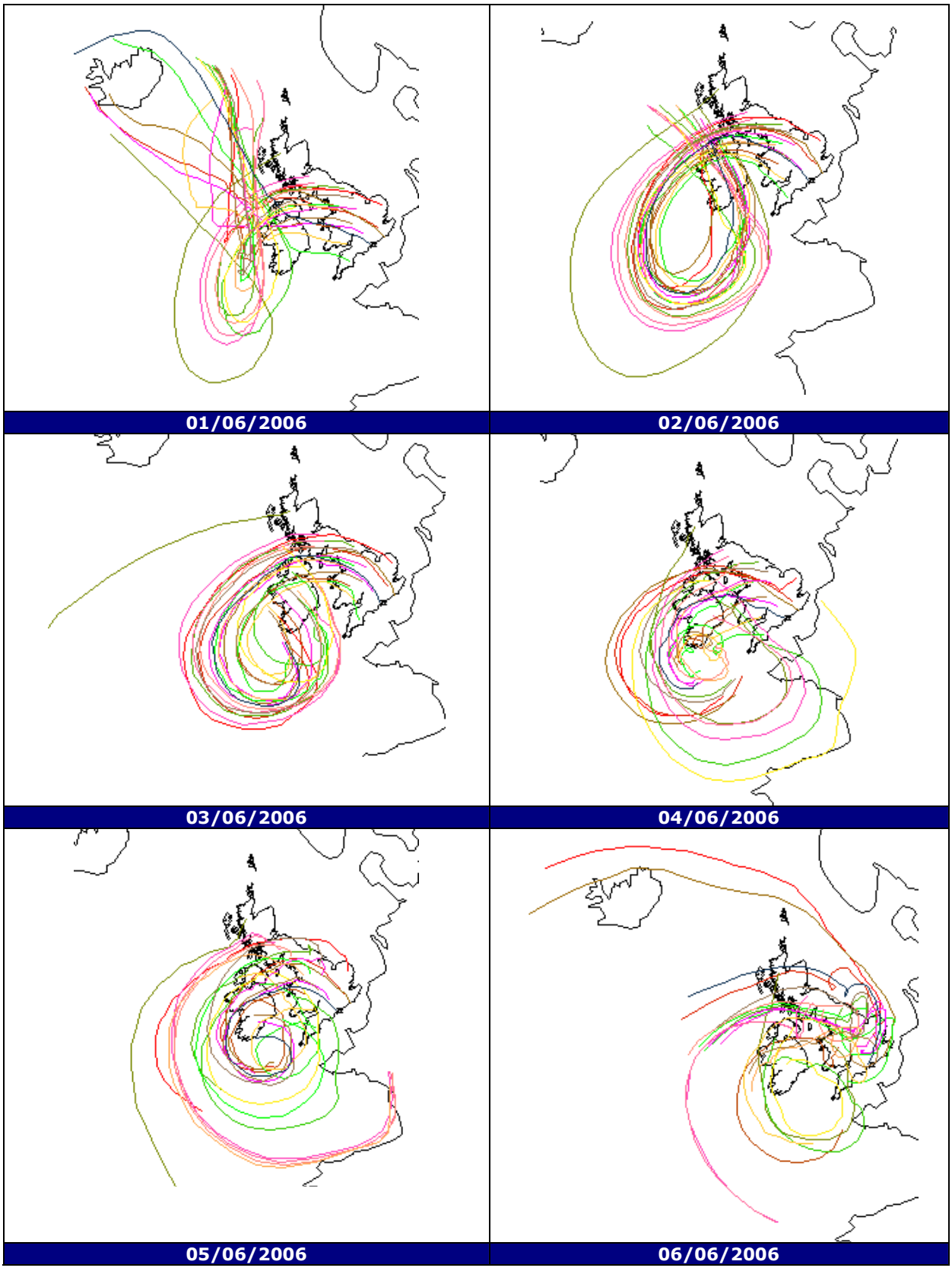
10 References

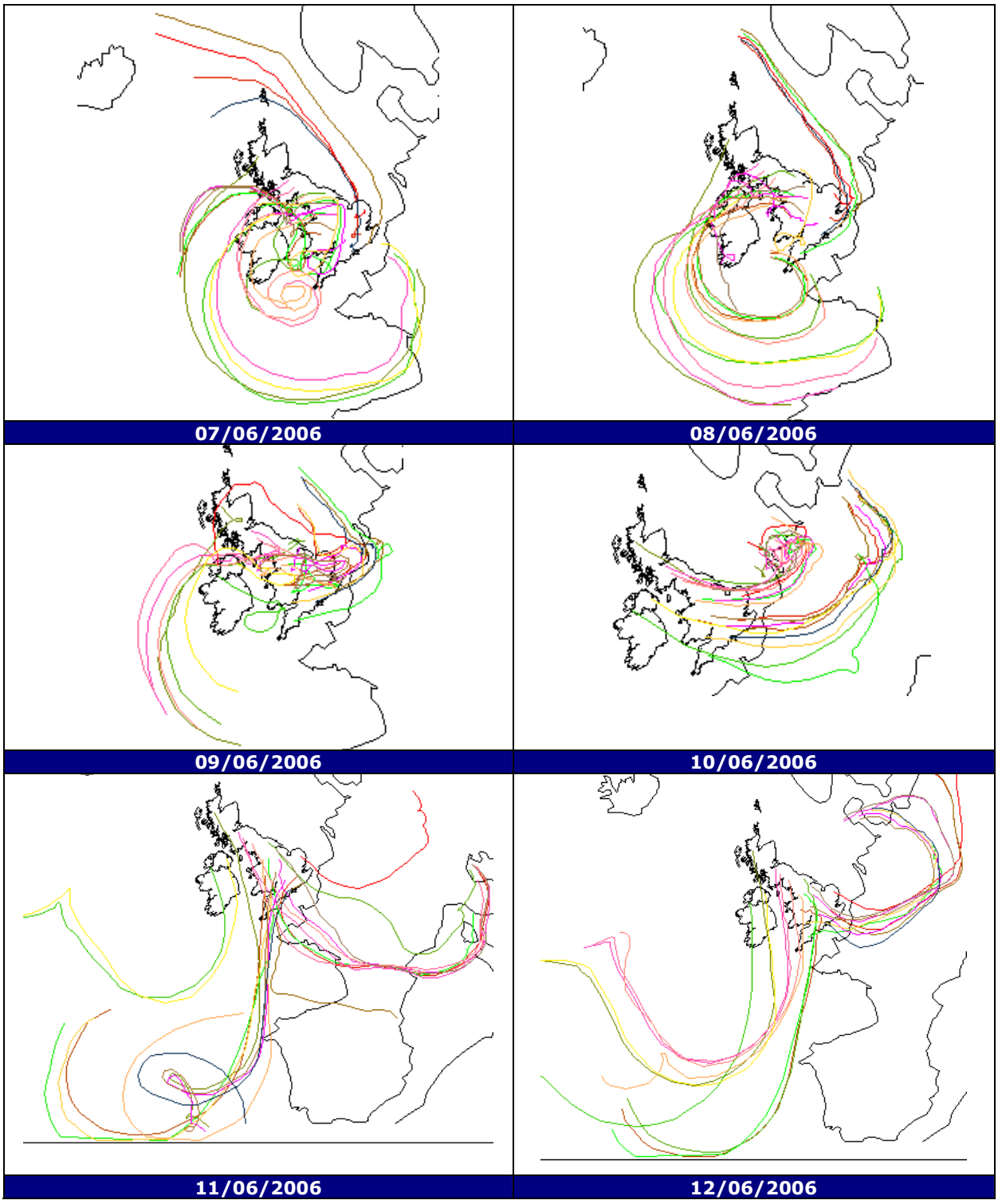
Kent, A (2003) Air Pollution Forecasting: Ozone Pollution Episode Report (August 2003)

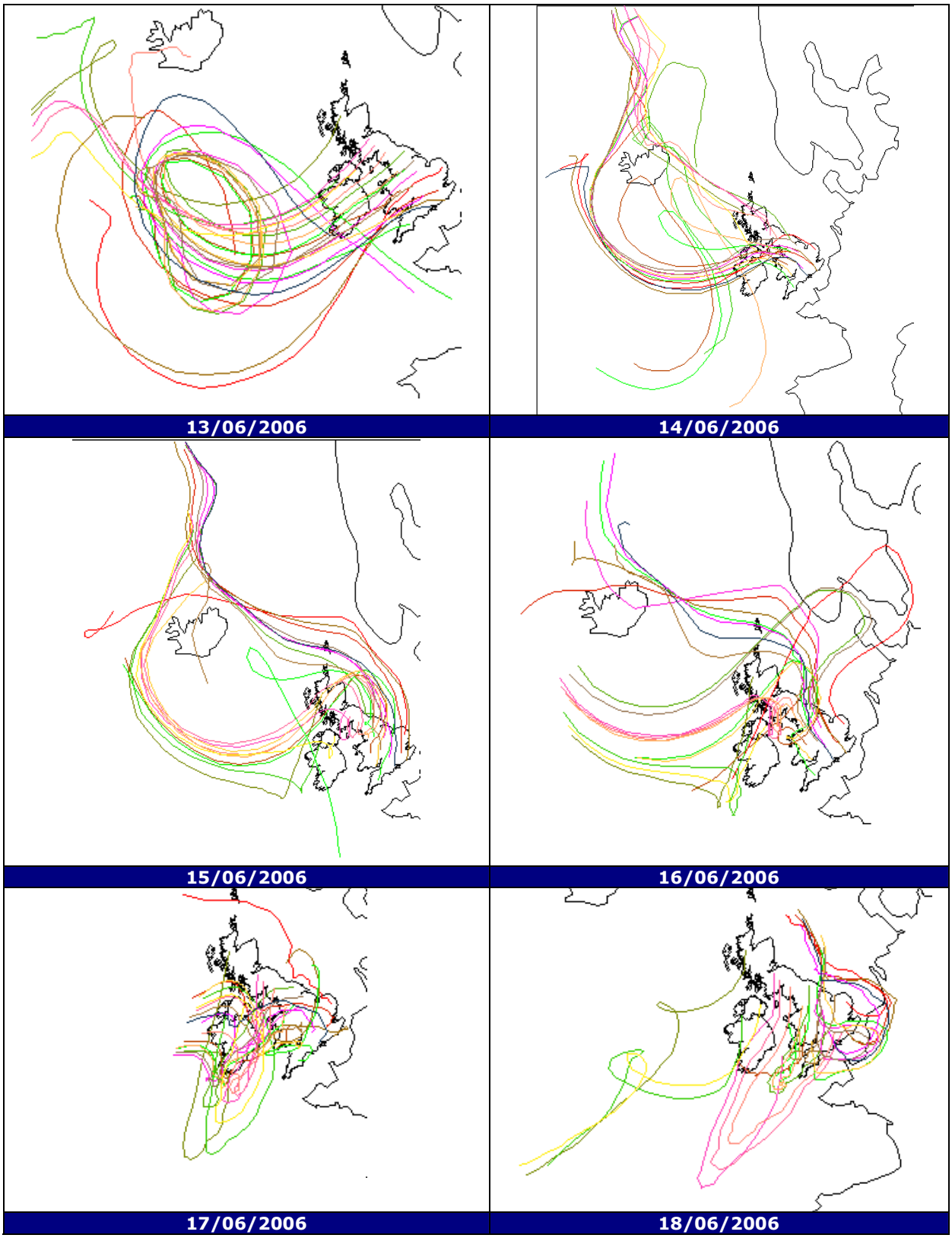
Targa, J (2004) Air Pollution Forecasting: Ozone Pollution Episode Report (July-August 2004)

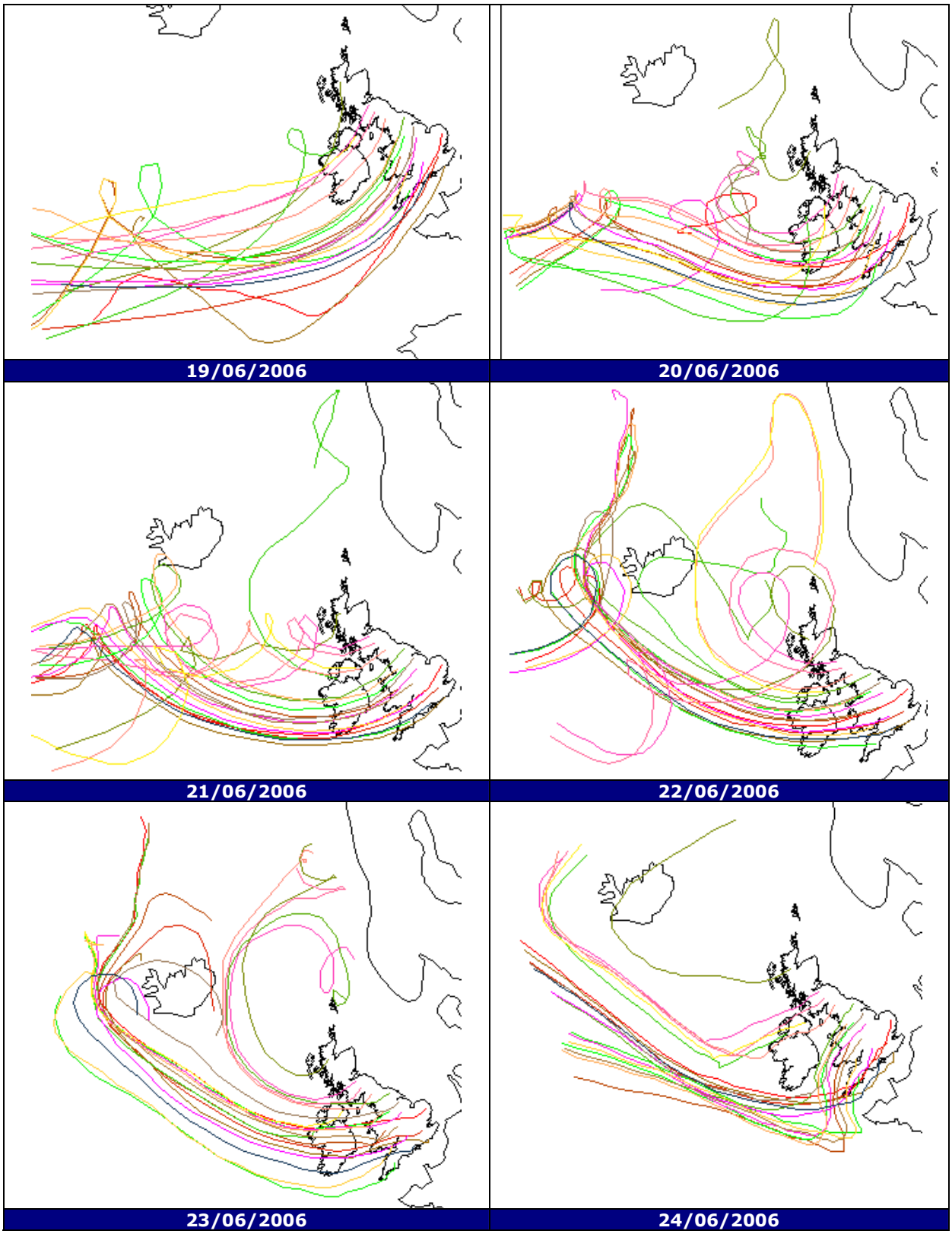
Targa, J (2005) **Air Pollution Forecasting: Ozone Pollution Episode Report (June-July 2005)**

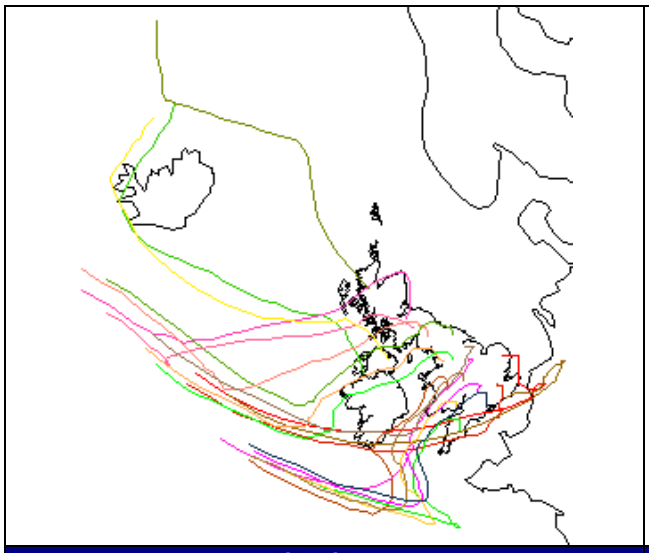
Appendix A – Daily 1000 mB 96-hour Forecast Air Back-Trajectories between June-July 2006


01/06/2006
02/06/2006
03/06/2006
04/06/2006
05/06/2006
06/06/2006

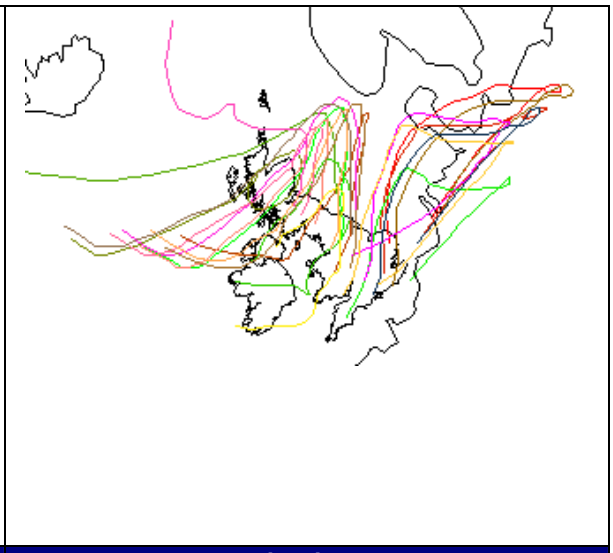

07/06/2006
08/06/2006
09/06/2006
10/06/2006
11/06/2006
12/06/2006


13/06/2006
14/06/2006
15/06/2006
16/06/2006
17/06/2006
18/06/2006

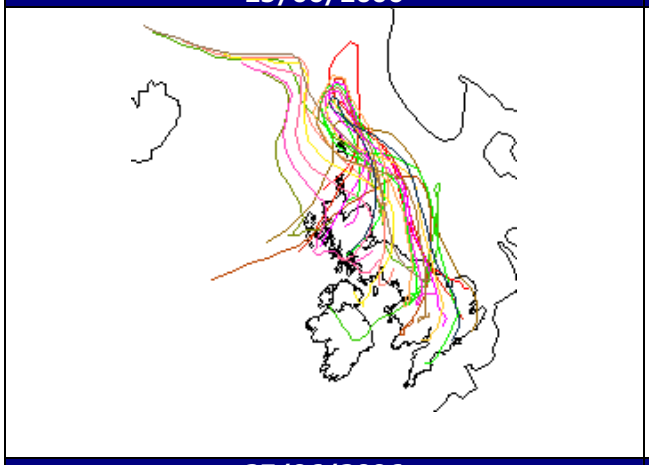

19/06/2006
20/06/2006
21/06/2006
22/06/2006
23/06/2006
24/06/2006



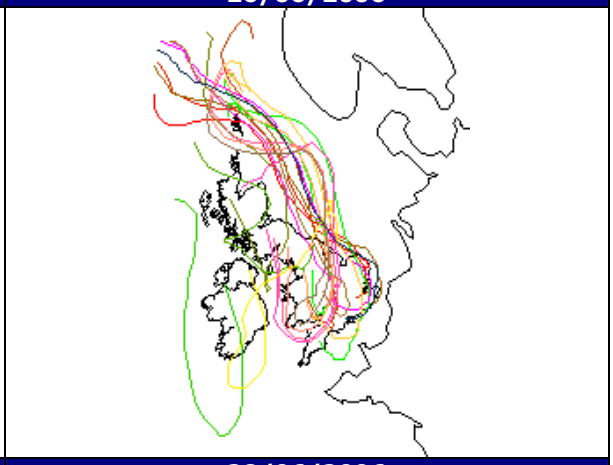
25/06/2006



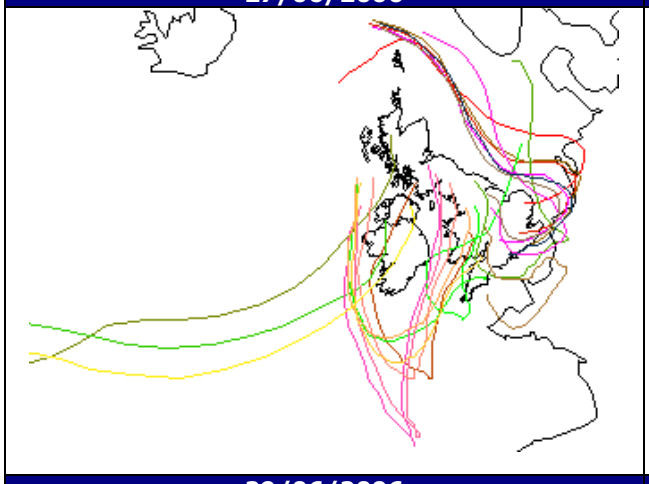
26/06/2006



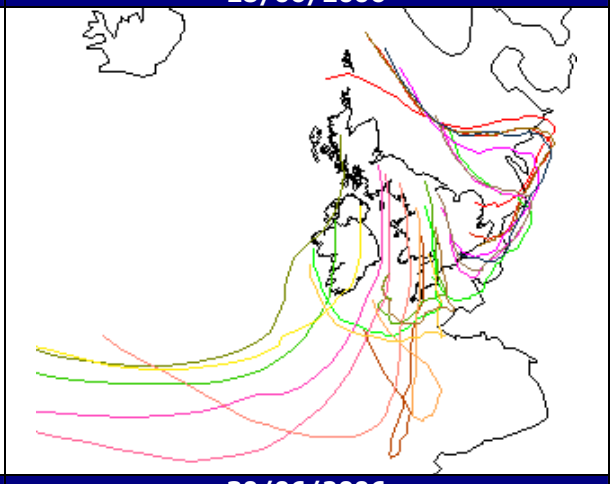
27/06/2006



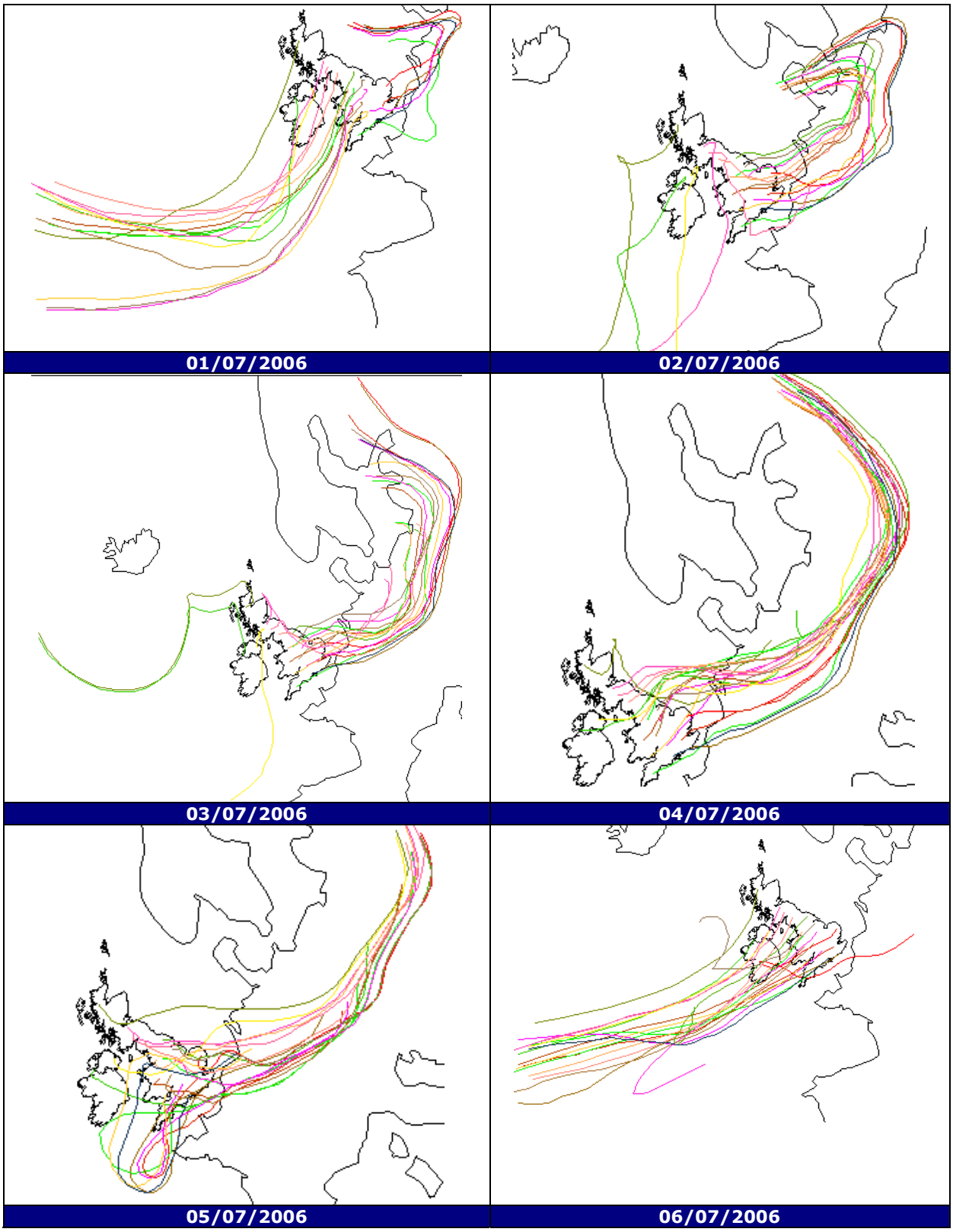
28/06/2006

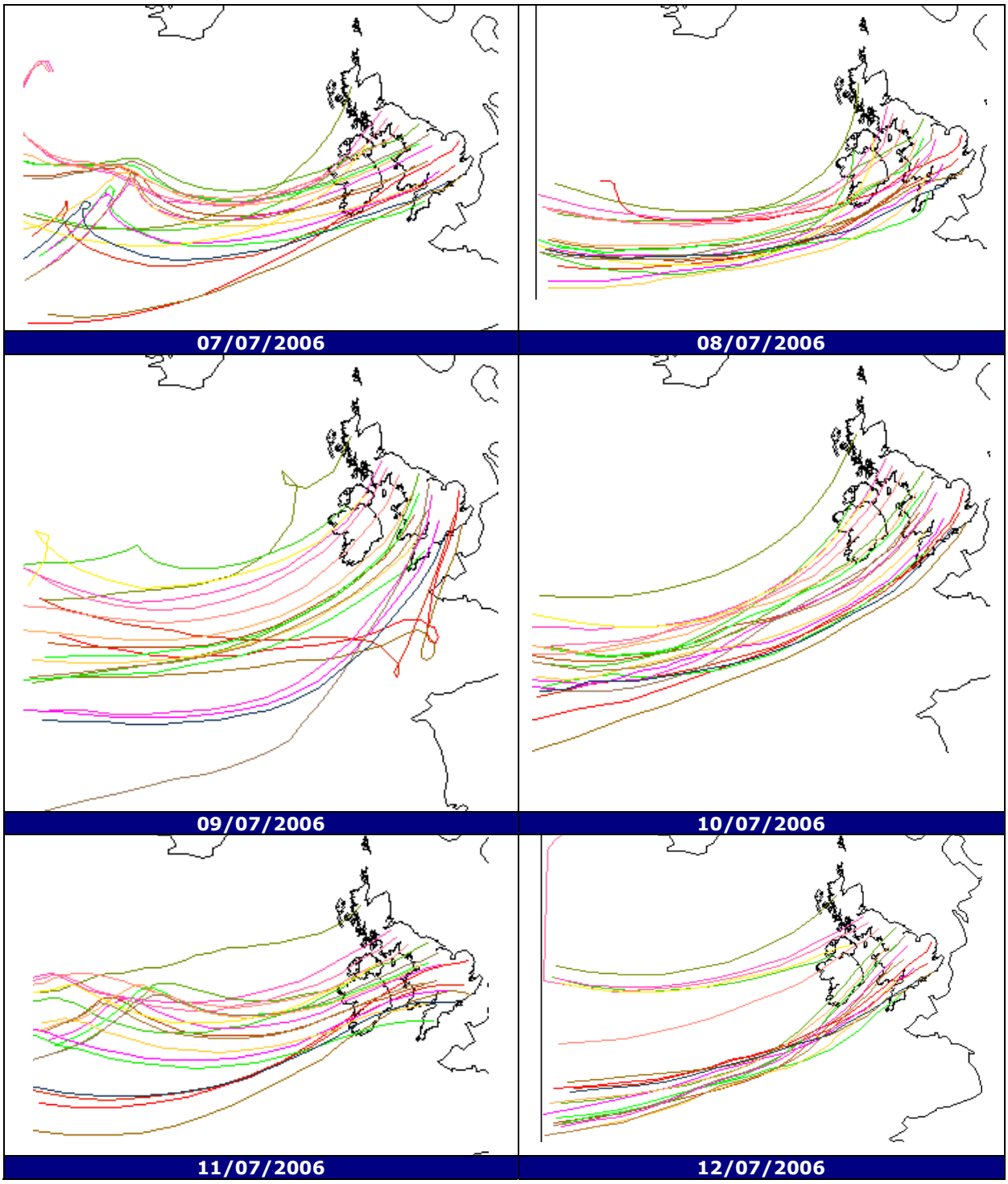


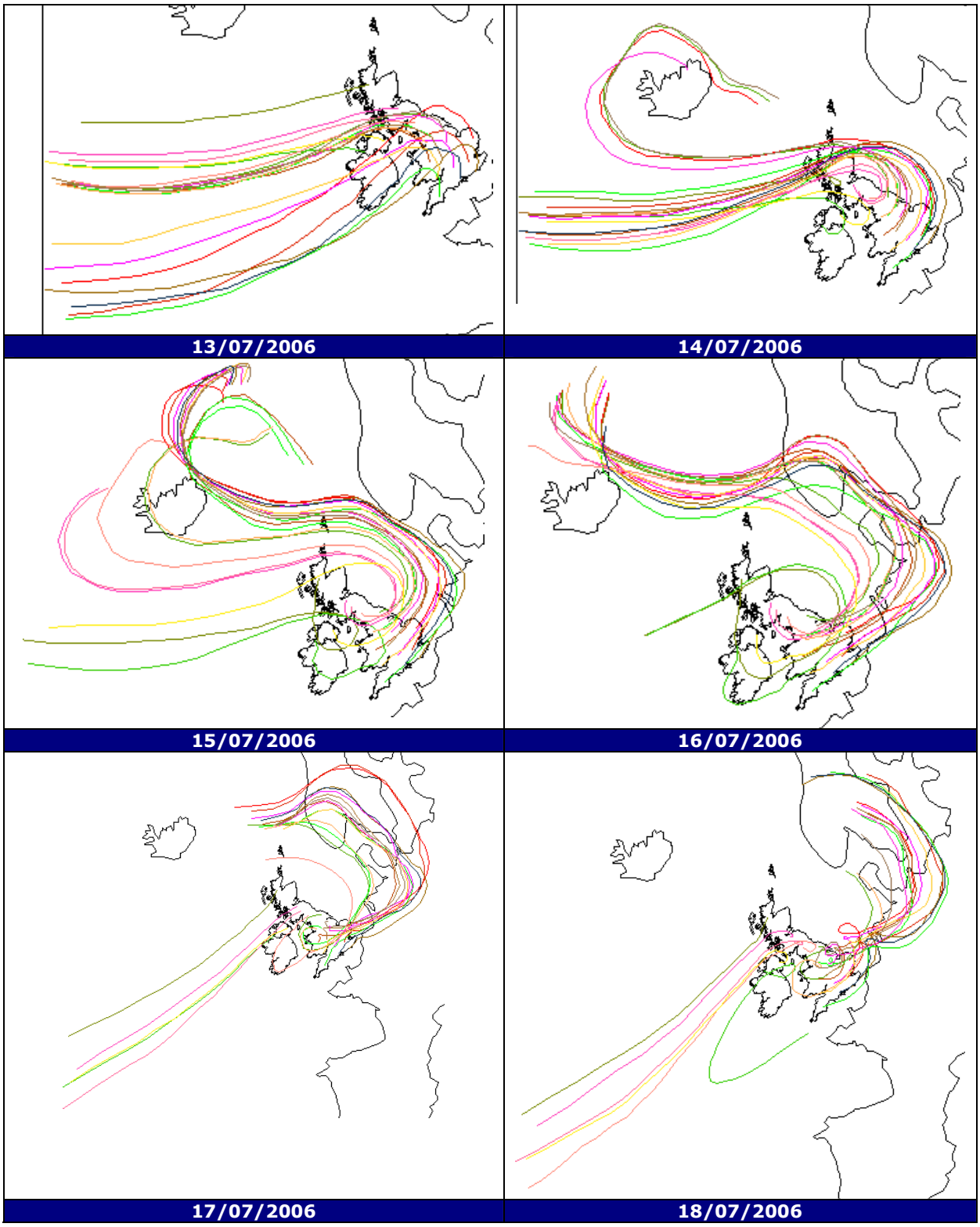
29/06/2006

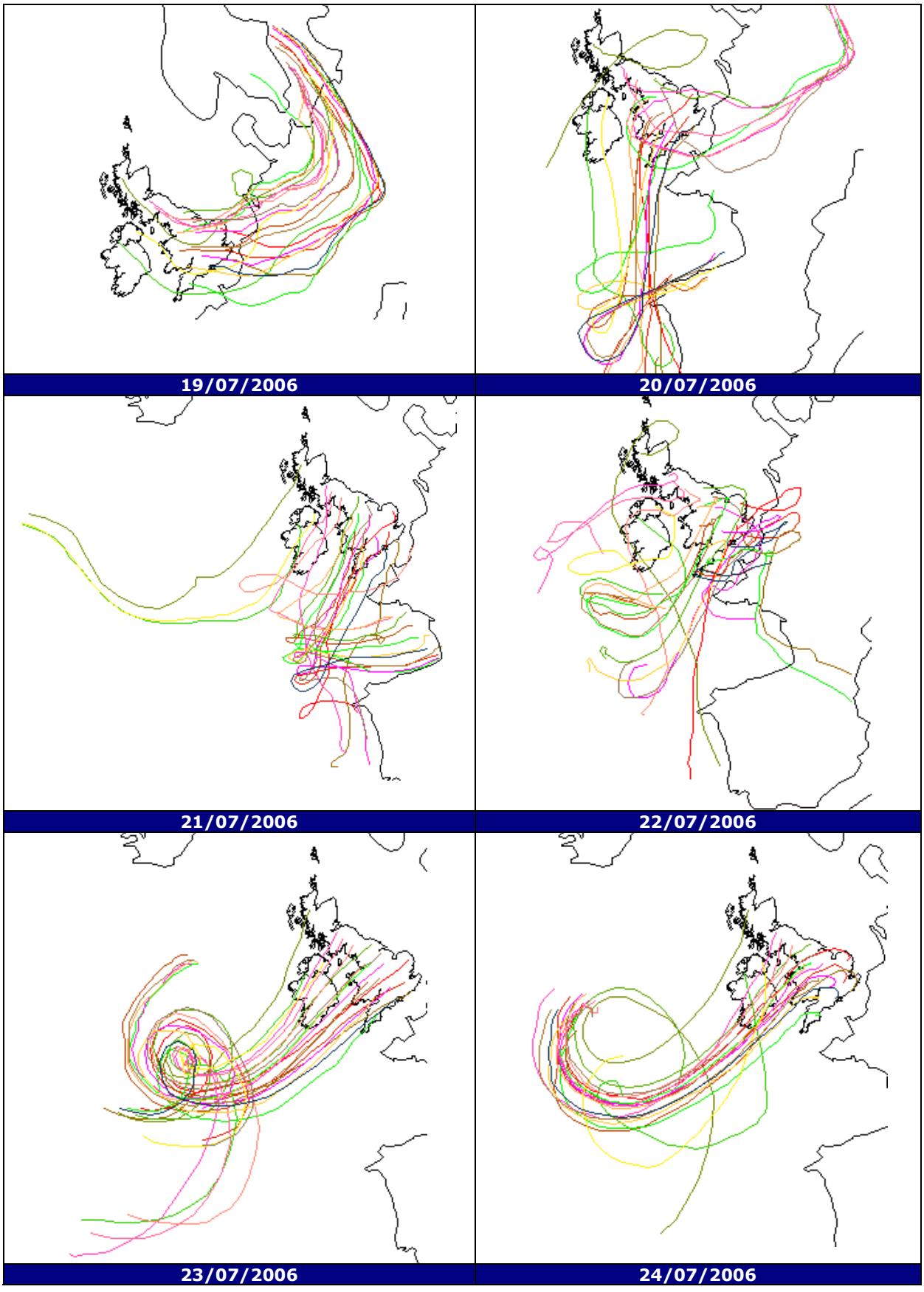


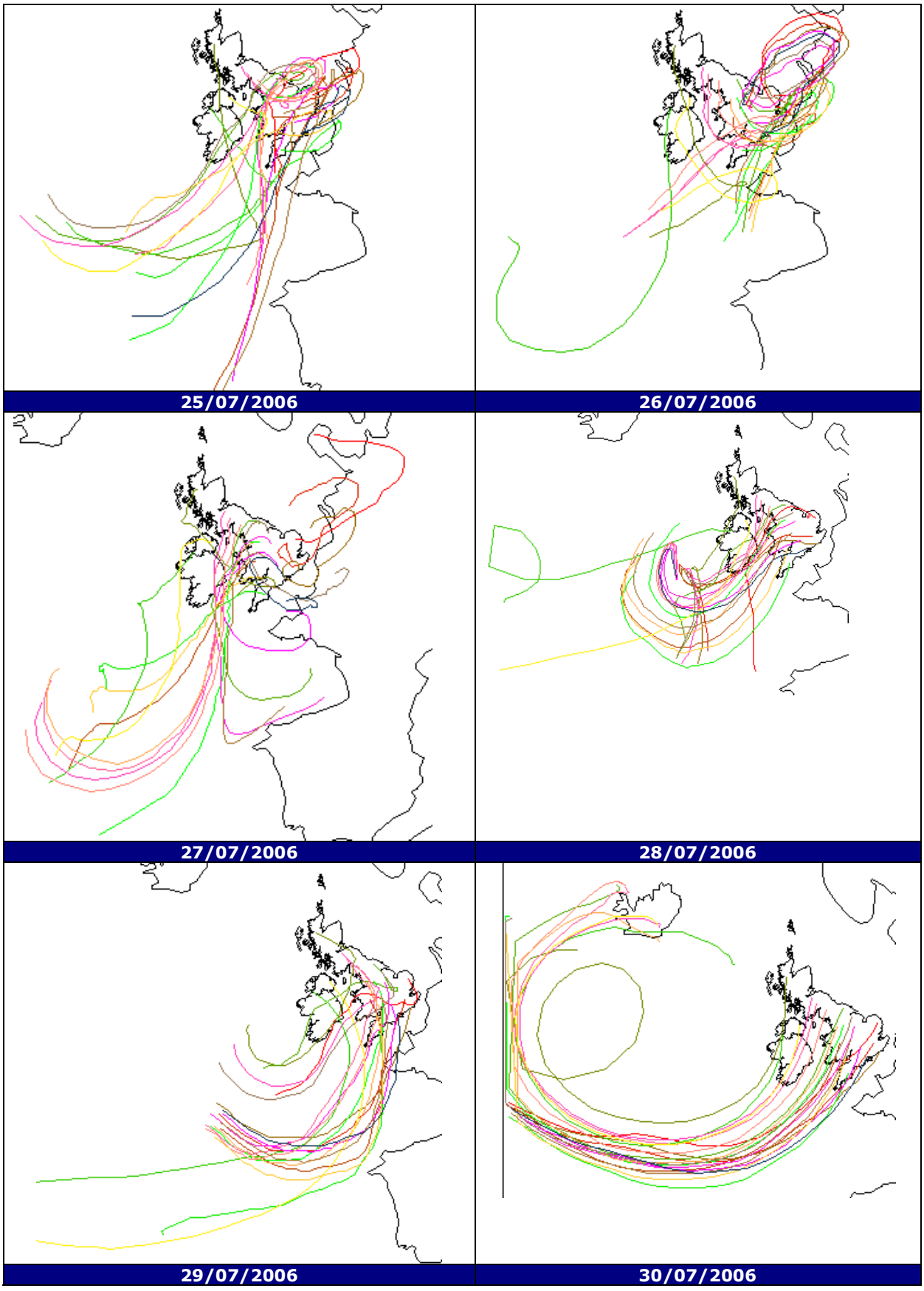
30/06/2006

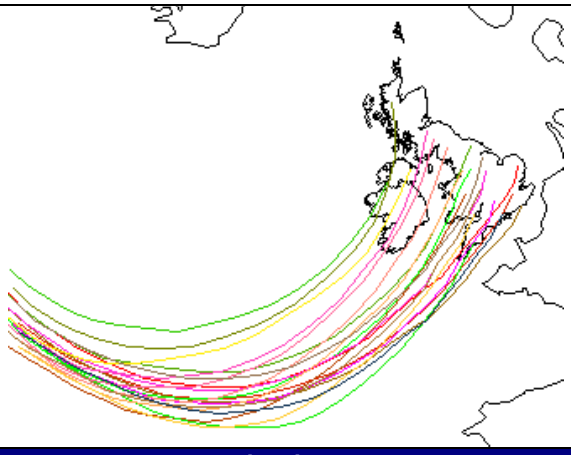

01/07/2006
02/07/2006
03/07/2006
04/07/2006
05/07/2006
06/07/2006


07/07/2006
08/07/2006
09/07/2006
10/07/2006
11/07/2006
12/07/2006


13/07/2006
14/07/2006
15/07/2006
16/07/2006
17/07/2006
18/07/2006


19/07/2006
20/07/2006
21/07/2006
22/07/2006
23/07/2006
24/07/2006

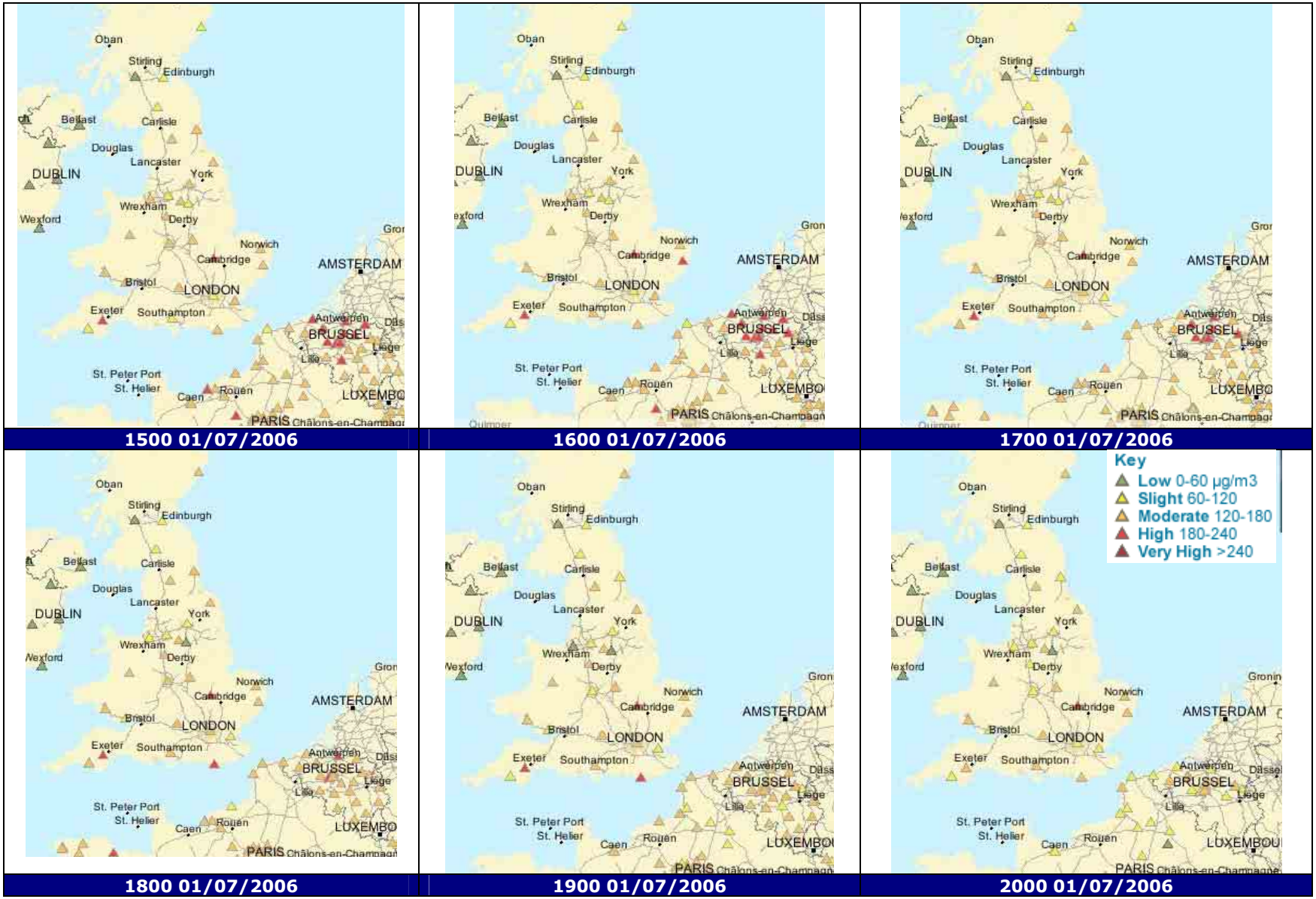

25/07/2006
26/07/2006
27/07/2006
28/07/2006
29/07/2006
30/07/2006

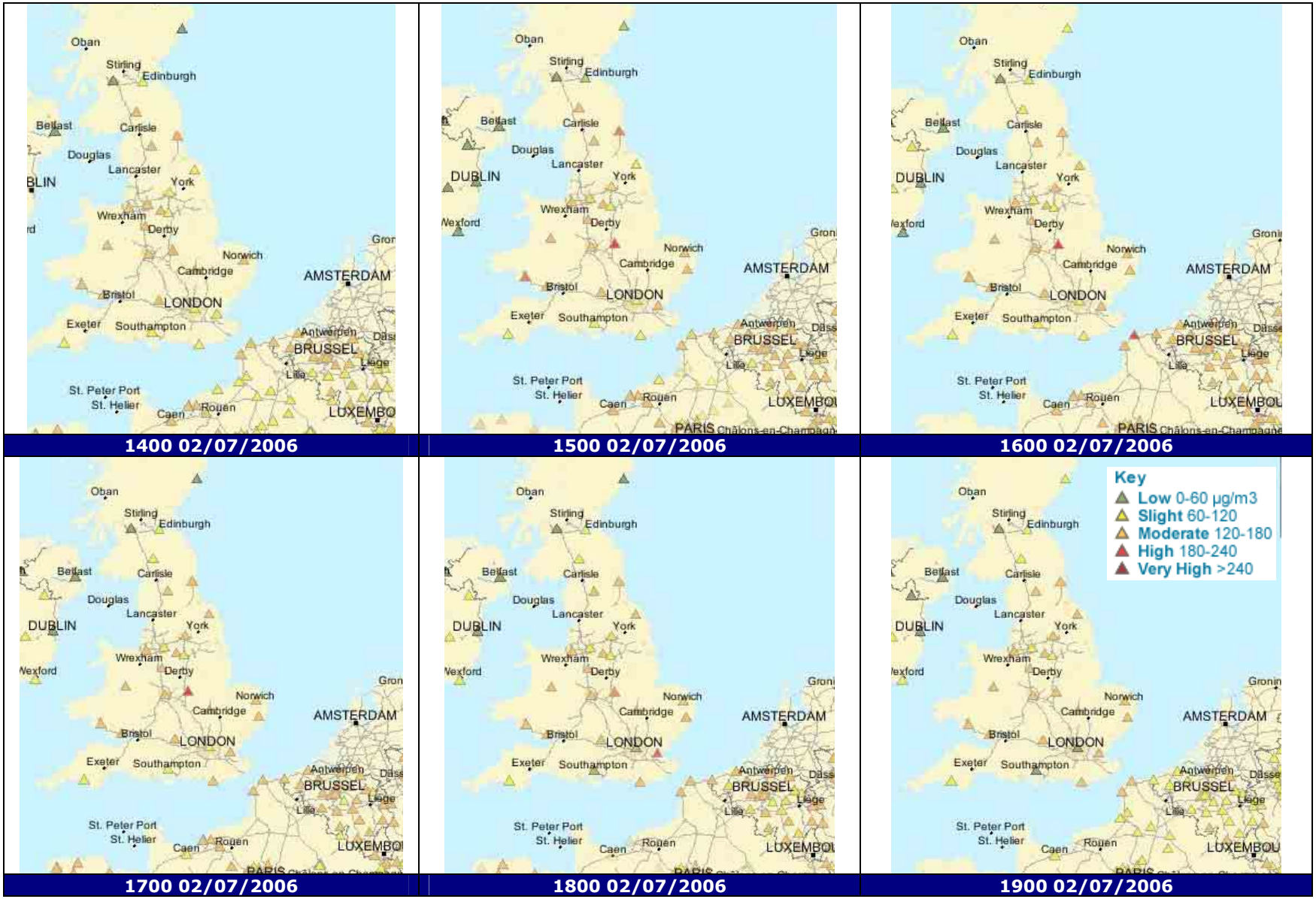


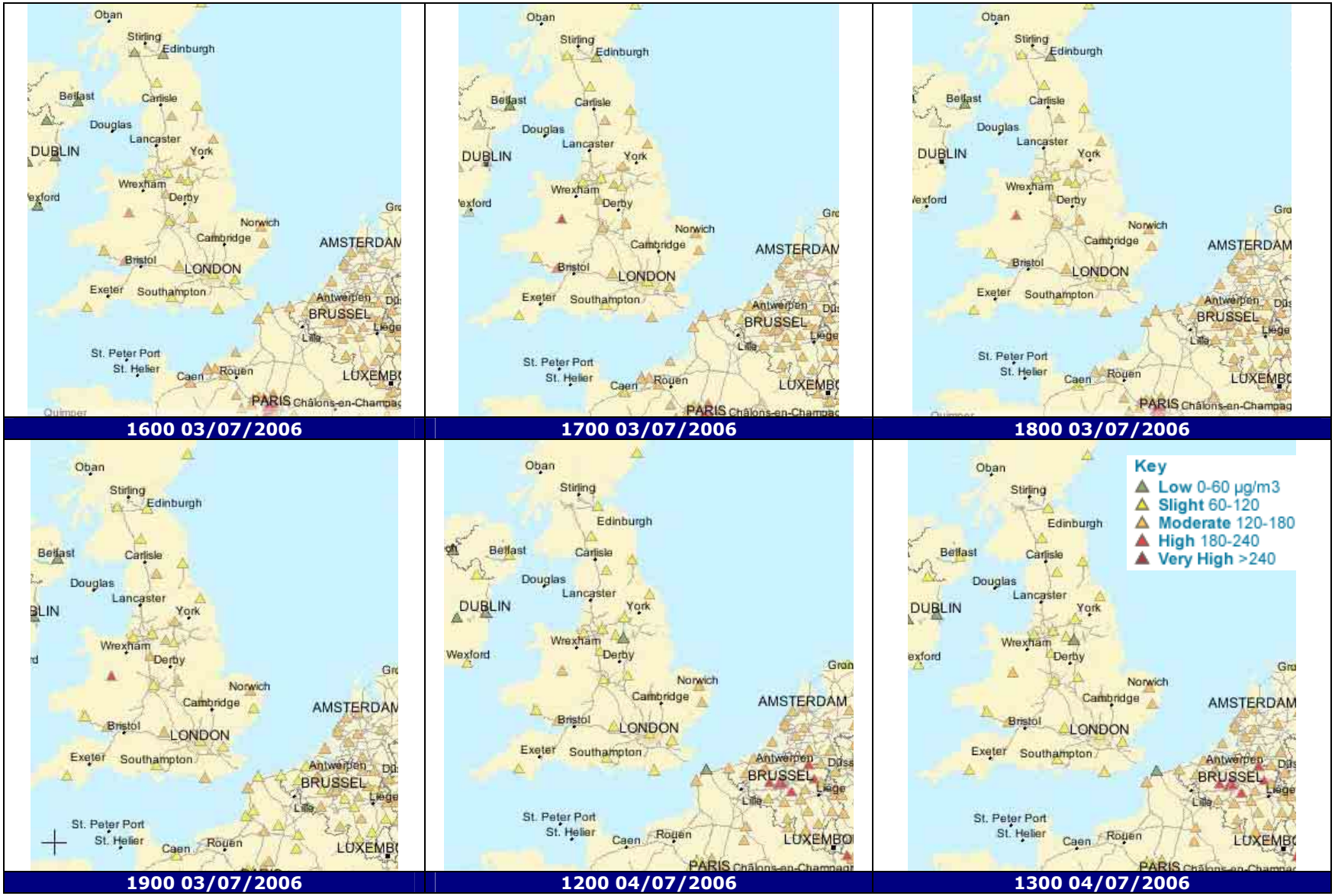
31/07/2006

Appendix B – Provisional Ozone levels across Northern Europe from EEA's Ozone Web

http://www.eea.europa.eu/maps/ozone/


Oban
Stirling
Edinburgh
Belfast
Carlisle
Douglas
Lancaster
DUBLIN
York
Wrexham
Derby
Norwich
Cambridge
AMSTERDAM
Bristol
LONDON
Exeter
Southampton
Antwerpen
BRUSSEL
Liege
Lille
St. Peter Port
St. Helier
Caen
Rouen
PARIS Châlons-en-Champagn
1500 01/07/2006
1600 01/07/2006
1700 01/07/2006
1800 01/07/2006
1900 01/07/2006
2000 01/07/2006
Key
Low 0-60 µg/m3
Slight 60-120
Moderate 120-180
High 180-240
Very High >240


Oban
Stirling
Edinburgh
Belfast
Carlisle
Douglas
Lancaster
York
Wrexham
Derby
Norwich
Cambridge
Bristol
LONDON
Exeter
Southampton
AMSTERDAM
Antwerpen
BRUSSEL
Liege
Lille
St. Peter Port
St. Helier
Caen
Rouen
DUBLIN
PARIS
1400 02/07/2006
1500 02/07/2006
1600 02/07/2006
1700 02/07/2006
1800 02/07/2006
1900 02/07/2006
Key
Low 0-60 µg/m3
Slight 60-120
Moderate 120-180
High 180-240
Very High >240


Oban
Stirling
Edinburgh
Belfast
Carlisle
Douglas
Lancaster
DUBLIN
York
Wrexham
Derby
Norwich
Cambridge
AMSTERDAM
Bristol
LONDON
Exeter
Southampton
Antwerpen
BRUSSEL
Lille
Liege
St. Peter Port
St. Helier
Caen
Rouen
PARIS
Châlons-en-Champag
1600 03/07/2006
1700 03/07/2006
1800 03/07/2006
1900 03/07/2006
1200 04/07/2006
1300 04/07/2006
Key
Low 0-60 µg/m3
Slight 60-120
Moderate 120-180
High 180-240
Very High >240

1400 04/07/2006

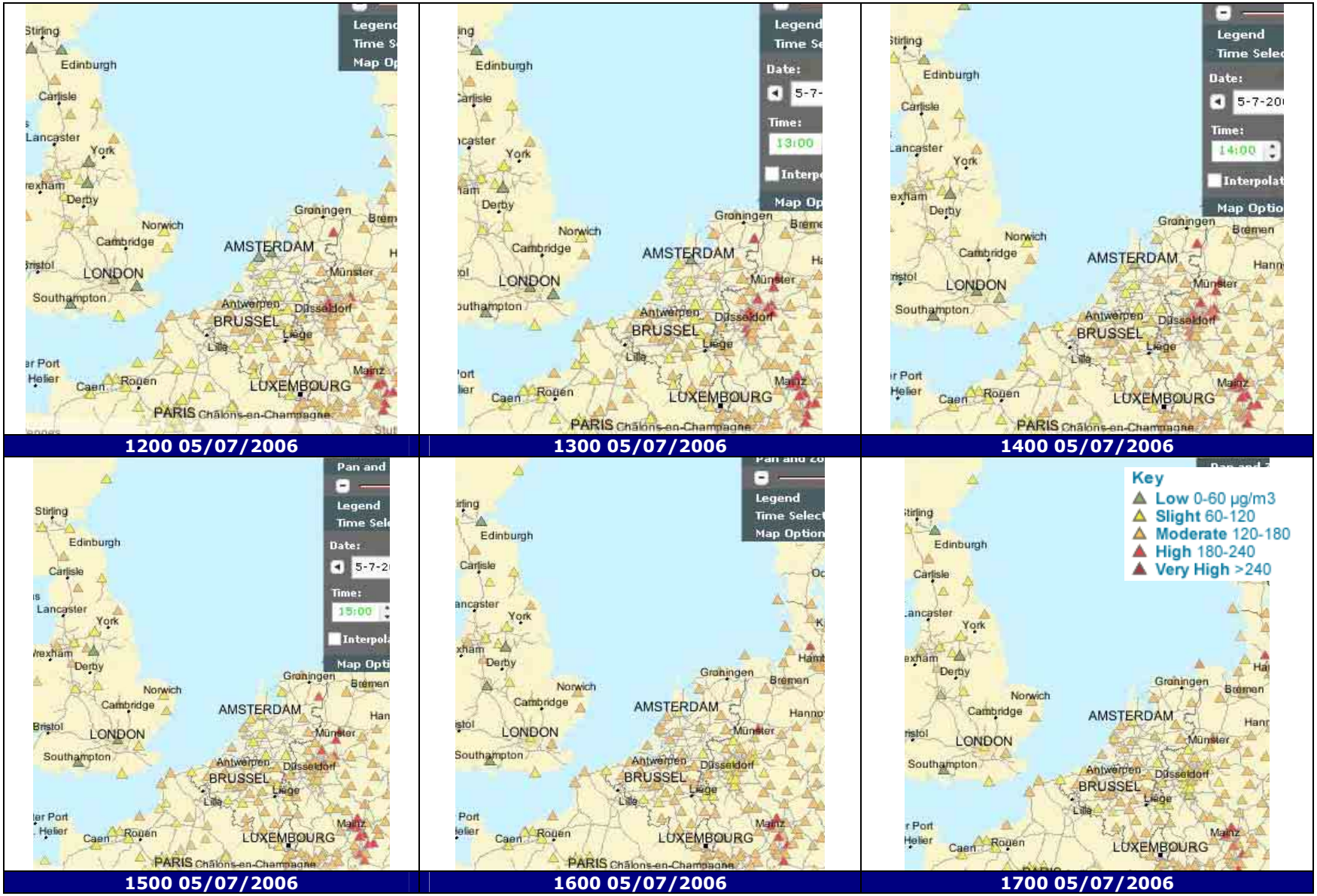
1500 04/07/2006

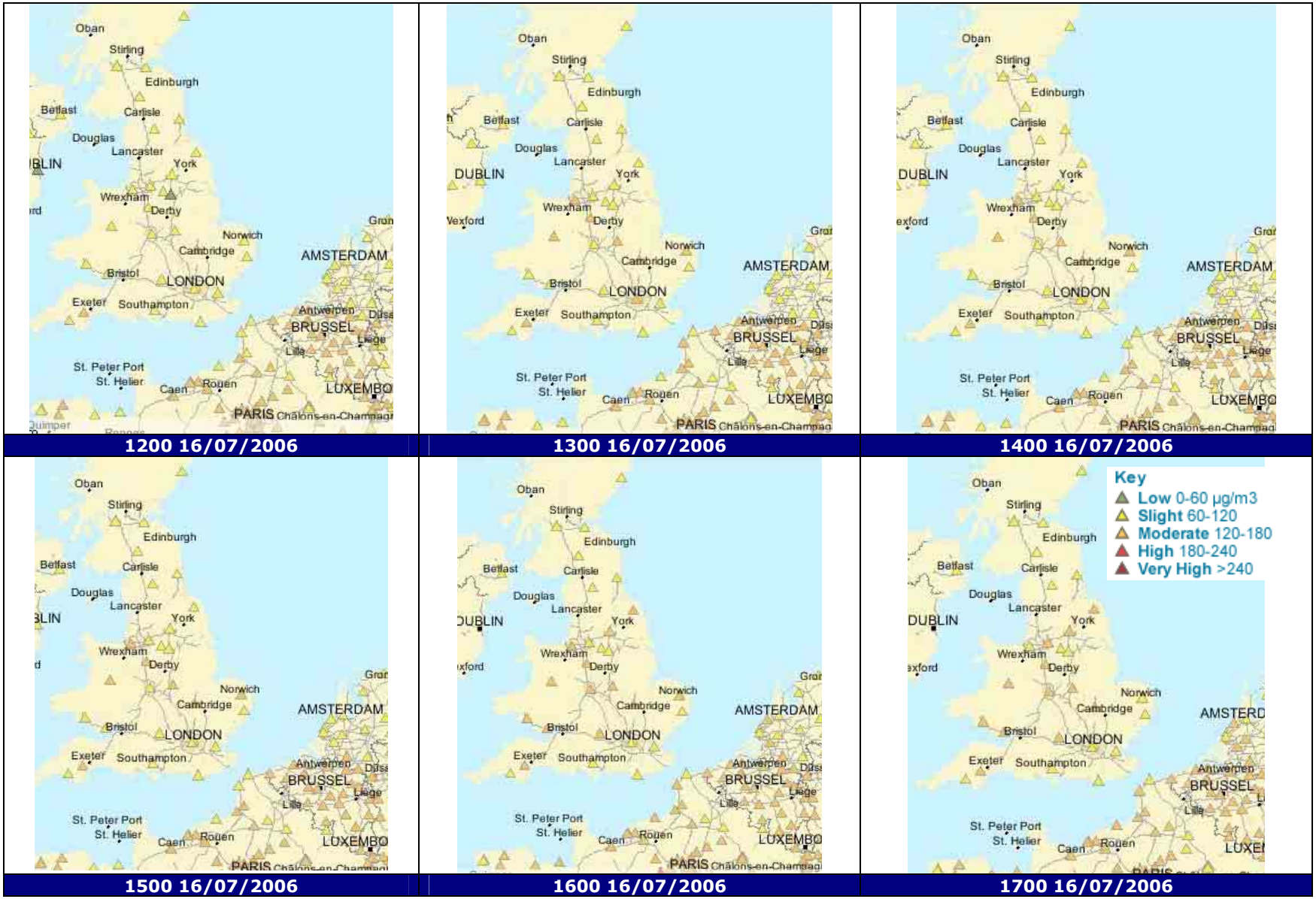
1600 04/07/2006

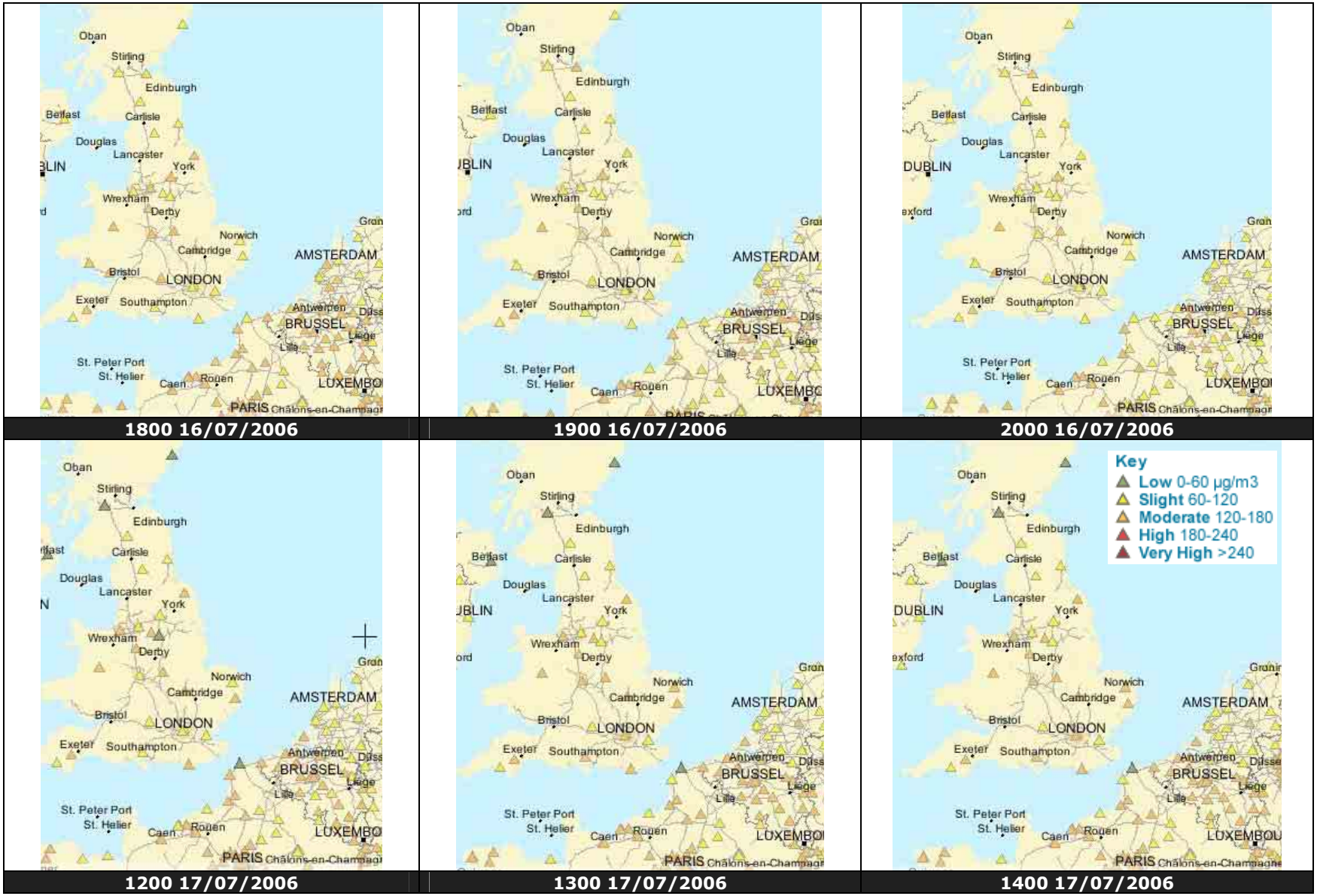
1700 04/07/2006

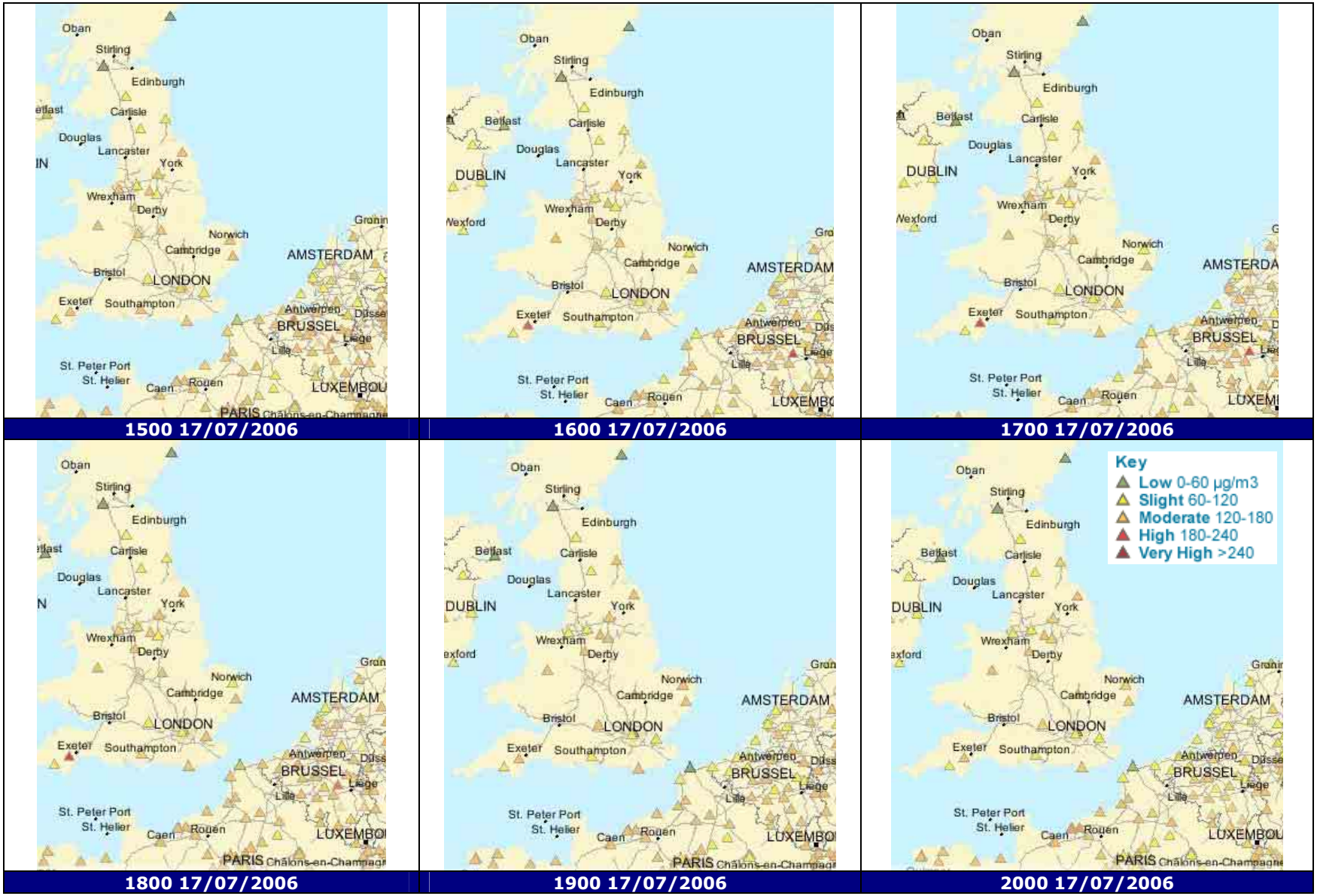
1800 04/07/2006

1900 04/07/2006


1200 05/07/2006
1300 05/07/2006
1400 05/07/2006
1500 05/07/2006
1600 05/07/2006
1700 05/07/2006
Key
Low 0-60 µg/m3
Slight 60-120
Moderate 120-180
High 180-240
Very High >240
Edinburgh
Carlisle
Lancaster
York
Derby
Norwich
Cambridge
LONDON
Southampton
AMSTERDAM
Groningen
Münster
Antwerpen
Düsseldorf
BRUSSEL
Liège
Lille
Caen
Rouen
LUXEMBOURG
Mainz
PARIS Châlons-en-Champagne


Oban
Stirling
Edinburgh
Belfast
Carlisle
Douglas
Lancaster
York
Wrexham
Derby
Norwich
Cambridge
Bristol
LONDON
Exeter
Southampton
AMSTERDAM
Antwerpen
BRUSSEL
Liege
Lille
St. Peter Port
St. Helier
Caen
Rouen
PARIS
1200 16/07/2006
1300 16/07/2006
1400 16/07/2006
1500 16/07/2006
1600 16/07/2006
1700 16/07/2006
Key
Low 0-60 µg/m3
Slight 60-120
Moderate 120-180
High 180-240
Very High >240


Oban
Stirling
Edinburgh
Belfast
Carlisle
Douglas
Lancaster
York
Wrexham
Derby
Norwich
Cambridge
AMSTERDAM
Bristol
LONDON
Exeter
Southampton
Antwerpen
BRUSSEL
Liege
Lille
St. Peter Port
St. Helier
Caen
Rouen
PARIS Châlons-en-Champagne
DUBLIN
1800 16/07/2006
1900 16/07/2006
2000 16/07/2006
1200 17/07/2006
1300 17/07/2006
1400 17/07/2006
Key
Low 0-60 µg/m3
Slight 60-120
Moderate 120-180
High 180-240
Very High >240


1500 17/07/2006
1600 17/07/2006
1700 17/07/2006
1800 17/07/2006
1900 17/07/2006
2000 17/07/2006
Key
Low 0-60 µg/m3
Slight 60-120
Moderate 120-180
High 180-240
Very High >240
Oban
Stirling
Edinburgh
Belfast
Carlisle
Douglas
Lancaster
York
DUBLIN
Wrexham
Derby
Norwich
Cambridge
Bristol
LONDON
Exeter
Southampton
AMSTERDAM
Antwerpen
BRUSSEL
Liege
Lille
St. Peter Port
St. Helier
Caen
Rouen
PARIS


Key
Low 0-60 µg/m3
Slight 60-120
Moderate 120-180
High 180-240
Very High >240
Oban
Stirling
Edinburgh
Belfast
Carlisle
Douglas
Lancaster
York
DUBLIN
Wrexham
Derby
Norwich
Cambridge
AMSTERDAM
Bristol
LONDON
Exeter
Southampton
Antwerpen
BRUSSEL
Liege
Lille
St. Peter Port
St. Helier
Caen
Rouen
LUXEMBOURG
PARIS Châlons-en-Champagne
1200 18/07/2006
1300 18/07/2006
1400 18/07/2006


Legend
Oban
Stirling
Edinburgh
Belfast
Carlisle
Douglas
Lancaster
York
Wrexham
Derby
Groningen
Bremen
Norwich
Cambridge
AMSTERDAM
Bristol
LONDON
Münster
Exeter
Southampton
Antwerpen
Düsseldorf
BRUSSEL
Liege
Lille
St. Peter Port
St. Helier
Caen
Rouen
Mainz
LUXEMBOURG
PARIS Châlons-en-Champagne
1500 18/07/2006
1600 18/07/2006
1700 18/07/2006

1800 18/07/2006

1900 18/07/2006

1200 19/07/2006

1300 19/07/2006

1400 19/07/2006

1500 19/07/2006

1600 19/07/2006

1700 19/07/2006

1800 19/07/2006

1900 19/07/2006

2000 19/07/2006

2100 19/07/2006

2200 19/07/2006

2300 19/07/2006

0000 20/07/2006

0100 20/07/2006

0200 20/07/2006

1200 20/07/2006

1300 20/07/2006

1400 20/07/2006

1500 20/07/2006

1600 20/07/2006

1700 20/07/2006

1800 20/07/2006

1900 20/07/2006

2000 20/07/2006

1200 21/07/2006

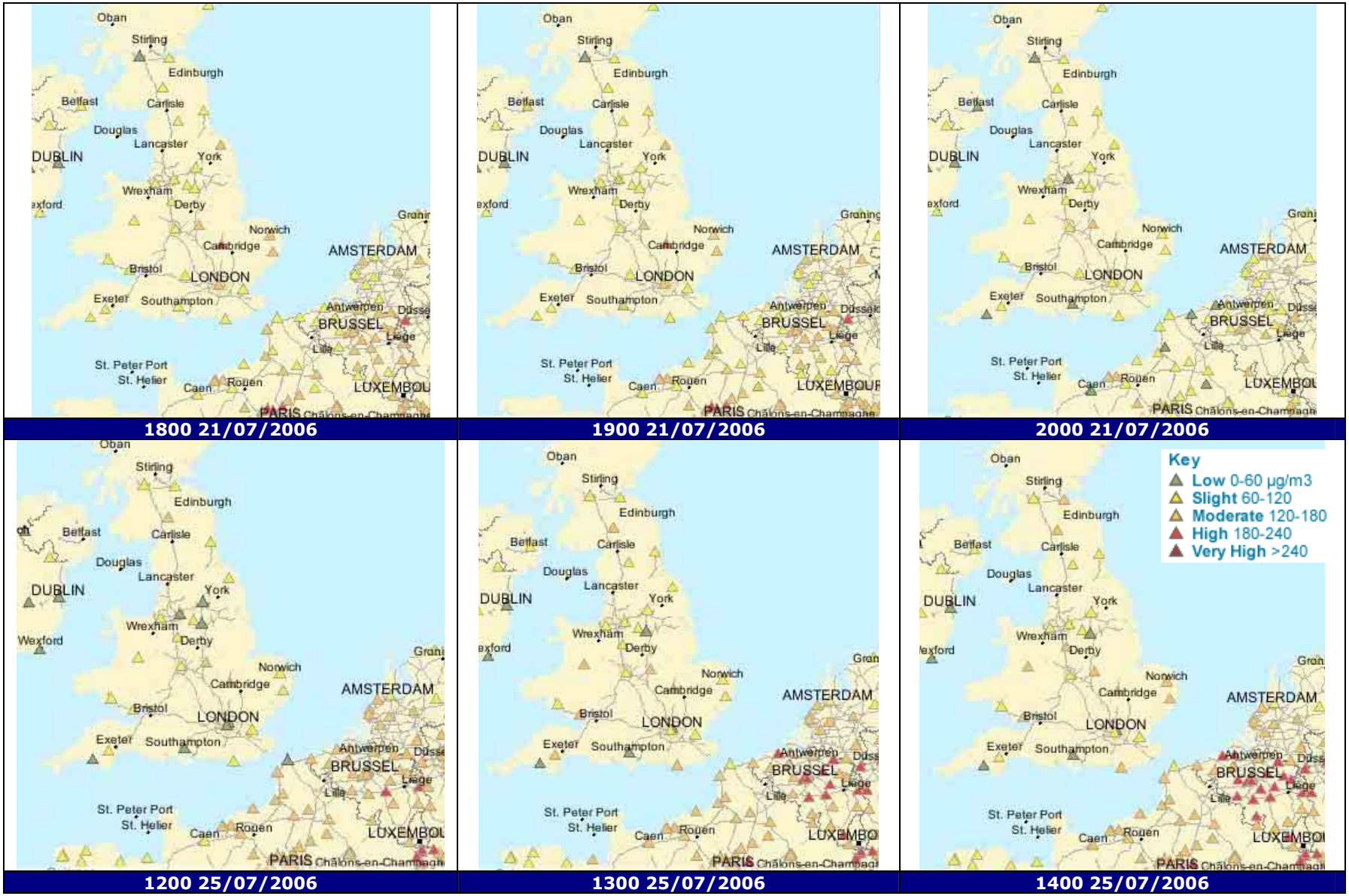
1300 21/07/2006

1400 21/07/2006

1500 21/07/2006

1600 21/07/2006

1700 21/07/2006



1800 21/07/2006 | 1900 21/07/2006 | 2000 21/07/2006

1200 25/07/2006 | 1300 25/07/2006 | 1400 25/07/2006

1500 25/07/2006

1600 25/07/2006

1700 25/07/2006

1800 25/07/2006

1900 25/07/2006

1200 26/07/2006

1300 26/07/2006

1400 26/07/2006

1500 26/07/2006

1600 26/07/2006

1700 26/07/2006

1800 26/07/2006

1900 26/07/2006

Appendix C – UK Air Pollution Bandings and Index and the Impact on the Health of People who are Sensitive to Air Pollution

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 $\mu g\ m^{-3}$	
		μgm^{-3}	ppb	μgm^{-3}	ppb	μgm^{-3}	ppb	mgm^{-3}	ppm	TEOM	(Grav. Equiv.)
LOW											
	1	0-32	0-16	0-95	0-49	0-88	0-32	0-3.8	0.0-3.2	0-16	0-21
	2	33-66	17-32	96-190	50-99	89-176	33-66	3.9-7.6	3.3-6.6	17-32	22-42
	3	67-99	33-49	191-286	100-149	177-265	67-99	7.7-11.5	6.7-9.9	33-49	43-64
MODERATE											
	4	100-126	50-62	287-381	150-199	266-354	100-132	11.6-13.4	10.0-11.5	50-57	65-74
	5	127-152	63-76	382–477	200-249	355-442	133-166	13.5-15.4	11.6-13.2	58-66	75-86
	6	153-179	77-89	478-572	250-299	443-531	167-199	15.5-17.3	13.3-14.9	67-74	87-96
HIGH											
	7	180-239	90-119	573-635	300-332	532-708	200-266	17.4-19.2	15.0-16.5	75-82	97-107
	8	240-299	120-149	636-700	333-366	709-886	267-332	19.3-21.2	16.6-18.2	83-91	108-118
	9	300-359	150-179	701-763	367-399	887-1063	333-399	21.3-23.1	18.3-19.9	92-99	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	≥ 100	≥ 130

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.