



# Summer Heatwave 2006 – Ozone Pollution Episode

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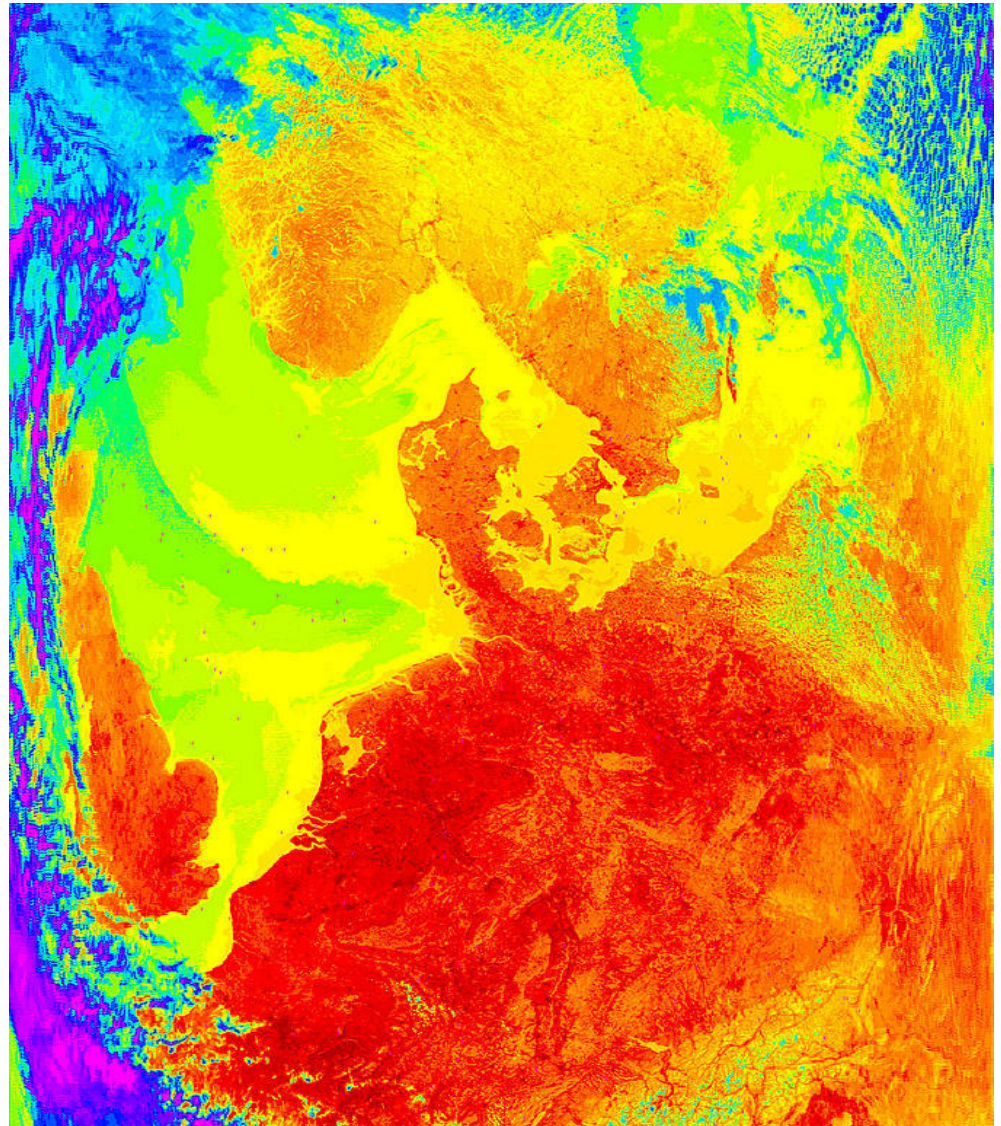
**Paul Willis**

16/05/2007

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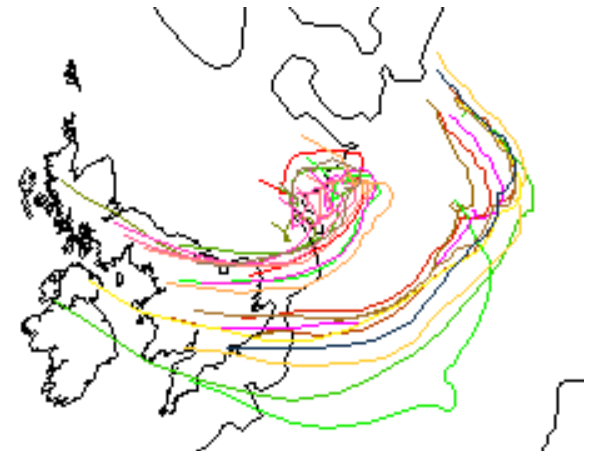
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# Introduction

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- Elevated ozone levels are usually observed during periods with sustained high temperatures and sunshine levels
- Photochemical reactions in the atmosphere that produce ozone are favoured by such conditions
- High temperatures, coupled with the re-circulation of air masses over Europe and the UK are often conducive to ozone pollution episodes

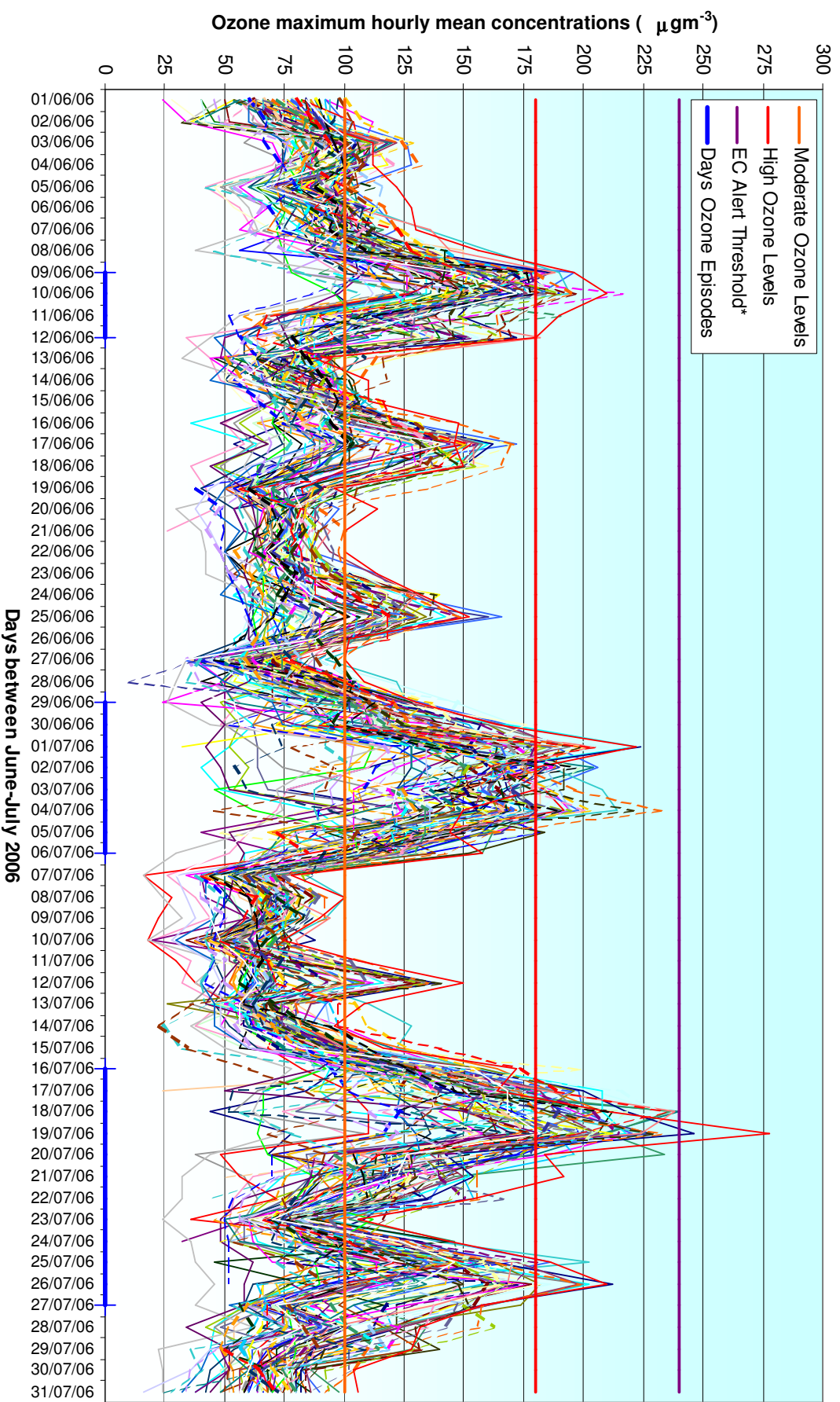


# Introduction

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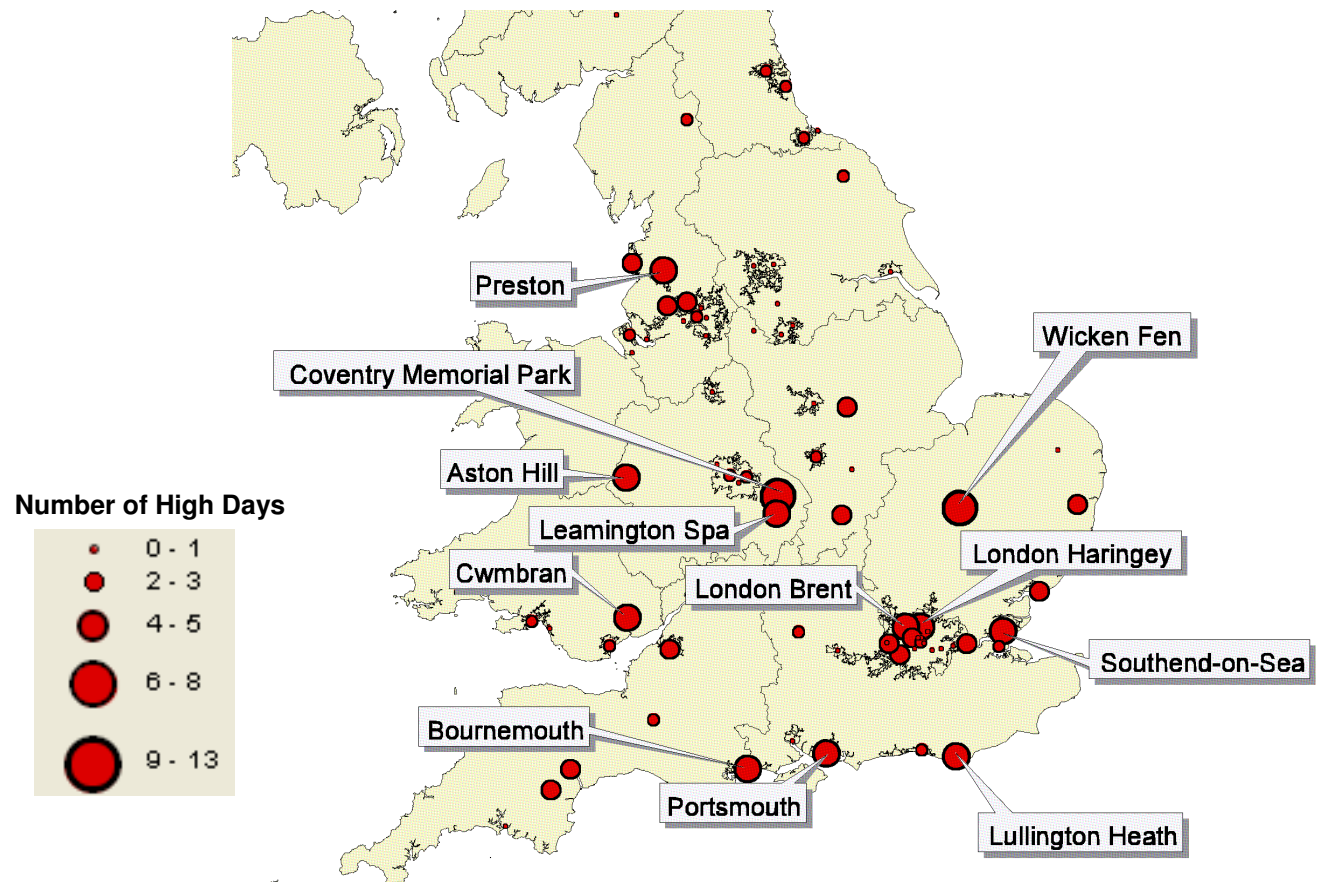
- HIGH levels of air pollution were measured across the Automatic Urban and Rural Network (AURN) during June and July 2006.
- The AURN recorded ozone levels in **Defra index 8 HIGH band** (240-299  $\mu\text{g}\text{m}^{-3}$ ) at three stations:
  - Wicken Fen,
  - London Haringey and
  - Blackpool Marton.
- The 3rd Daughter Directive (Directive 2002/3/EC) on ozone in ambient air has established an alert threshold of 240  $\mu\text{g}\text{m}^{-3}$  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  $\mu\text{g}\text{m}^{-3}$ .

# Defining the episode



# Defining the episode

- 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



# Weather Conditions

- June and July were very warm and dry over England and Wales
- July was exceptionally hot, with recorded temperatures of 36°C on 19th July setting a new UK July temperature record

June	July
<p>A very warm, dry and sunny month across most areas. Mean temperatures generally <b>1-2°C above average</b>. Rainfall ranging from close to average across western Scotland, to exceptionally below average across the Midlands. <b>Sunshine levels well above average across southern England.</b></p> <p><b>Central London recorded a maximum temperature of 32.4 C on 12th.</b></p> <p>Source: <a href="http://www.met.gov.uk/climate/uk/2006/index.html">http://www.met.gov.uk/climate/uk/2006/index.html</a></p>	<p><b>An exceptionally warm month.</b> Many areas had their warmest July, with <b>some areas also experiencing their warmest month</b> (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.</p> <p><b>Wisley recorded a temperature of 36.5 °C on 19th July setting a new UK July temperature record.</b></p>

# Air Quality Monitoring

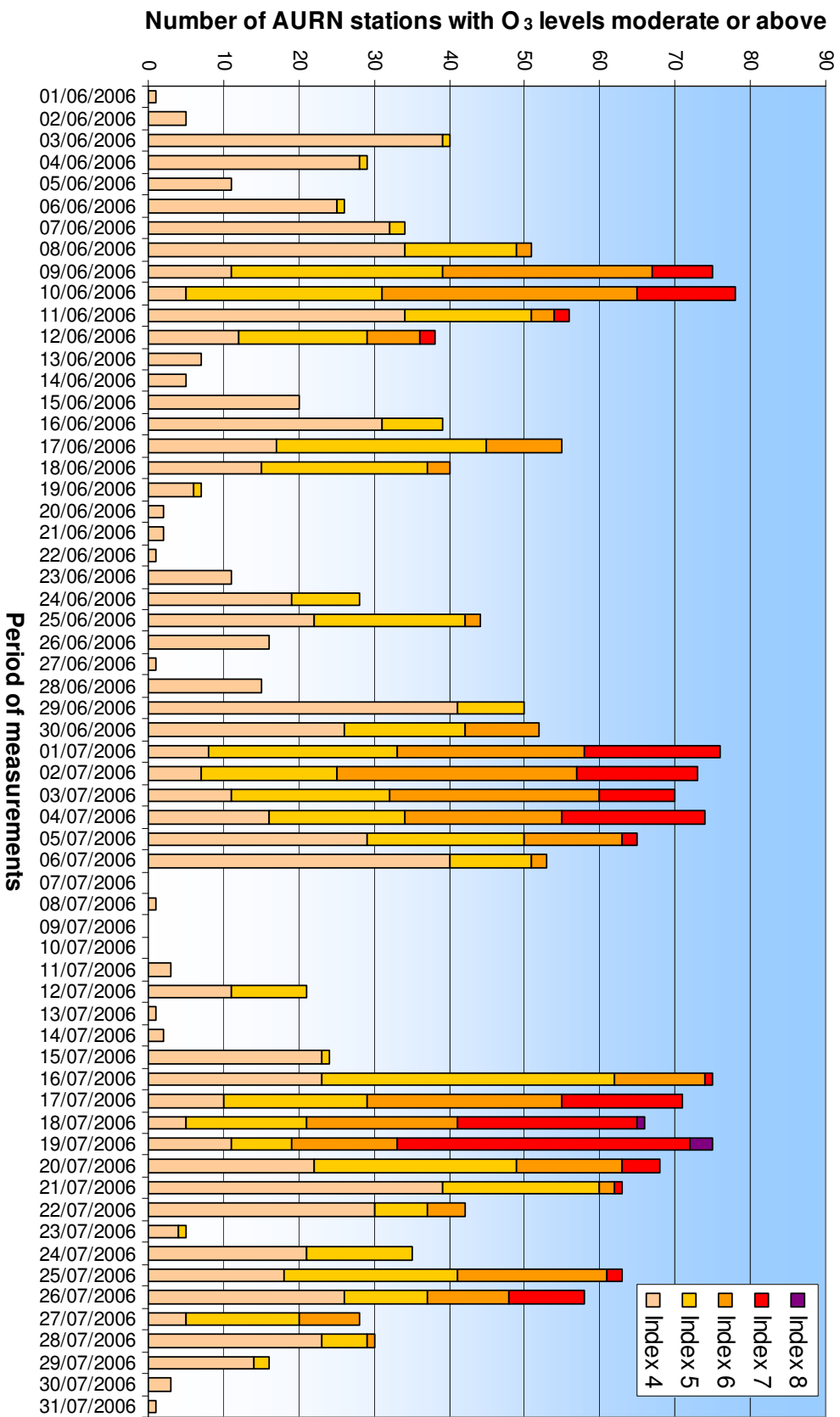
Site	Number of Days		Max hourly ( $\mu\text{g}\text{m}^{-3}$ )	Date of hourly max concentration
	High	Moderate		
Wicken Fen	13	41	278	19/07/06
Southend-on-Sea	8	38	232	04/07/06
Stoke-on-Trent Centre	8	24	244	19/07/06
Preston	7	18	218	18/07/06
Aston Hill	6	26	220	19/07/06
Bournemouth	6	21	232	18/07/06
Leamington Spa	6	25	228	19/07/06
London Brent	6	28	222	01/07/06
London Haringey	6	25	246	19/07/06
Lullington Heath	6	29	238	18/07/06
Portsmouth	6	27	230	18/07/06
Blackpool Marton	5	25	240	18/07/06
Bristol St Paul's	5	14	202	19/07/06
London N. Kensington	5	28	204	26/07/06
London Teddington	5	32	206	19/07/06
Northampton	5	24	214	19/07/06
Bottesford	4	27	196	20/07/06
Exeter Roadside	4	12	210	18/07/06
London Harlington	4	28	206	19/07/06
St Osyth	4	33	206	19/07/06
Wigan Centre	4	19	190	18/07/06



# Air Quality Monitoring – 20 years...

Year	Site	Country	Site type	Hourly Max µg m-3	Data Capture
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	Exeter Roadside	England	ROADSIDE	328	94.3
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

# Air Quality Monitoring

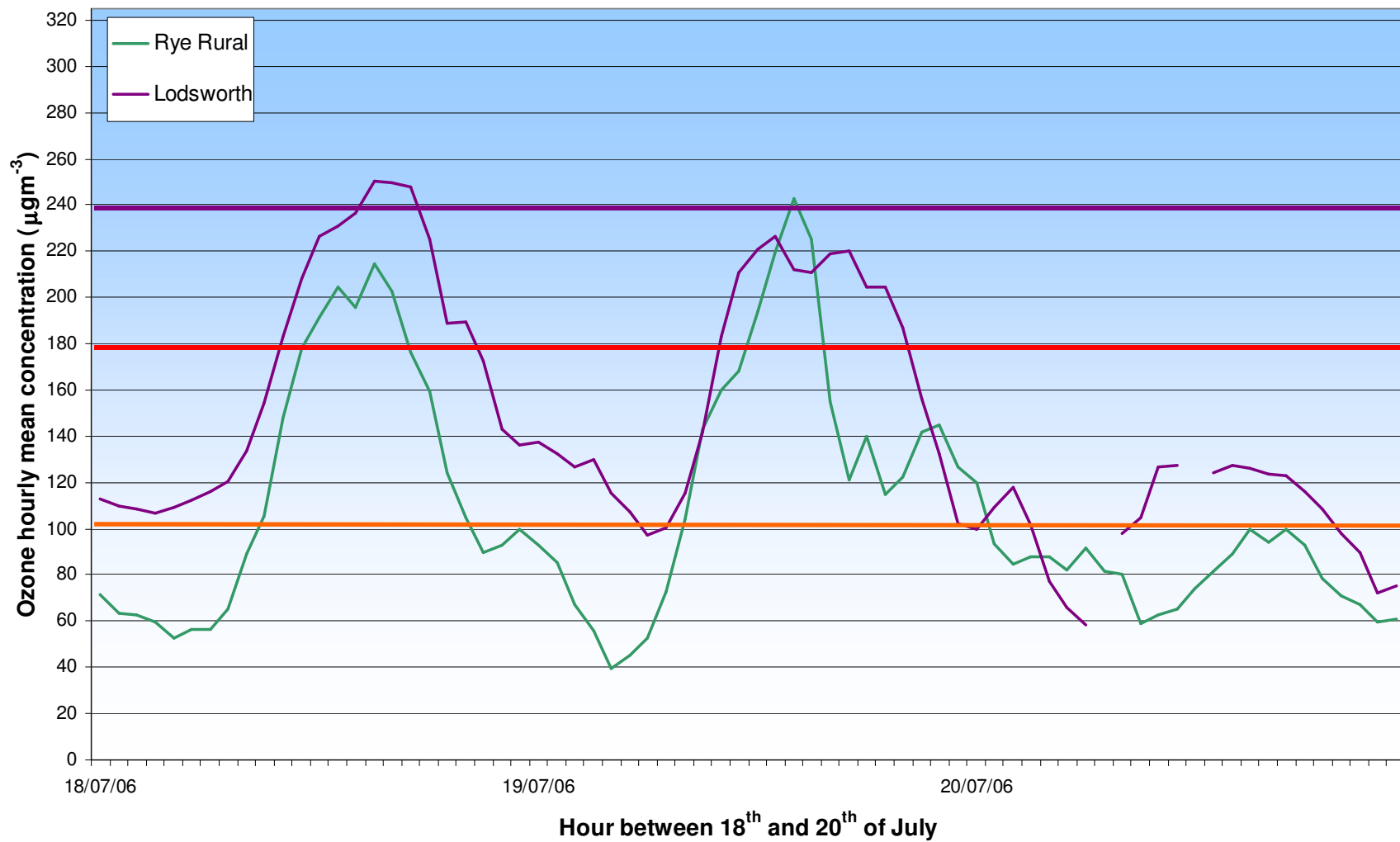


# Air Quality Monitoring – local networks

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- Ozone episode was measured in local networks like:
  - Herts & Beds Air Pollution Monitoring Network (HBAPMN)
  - London Air Quality Network (LAQN)
  - Kent Air Quality Monitoring Network (KAQMN)
  - Sussex Air
- The highest hourly ozone concentration measured was 251 mgm-3 at Lodsworth (Sussex Air) on 18th
- The 3rd Daughter Directive (Directive 2002/3/EC) alert threshold of 240 mgm-3 was exceeded at this location on 18th July. Three consecutive hours were measured above 240 mgm-3

# Air Quality Monitoring – local networks



# Reasons for Ozone Episode

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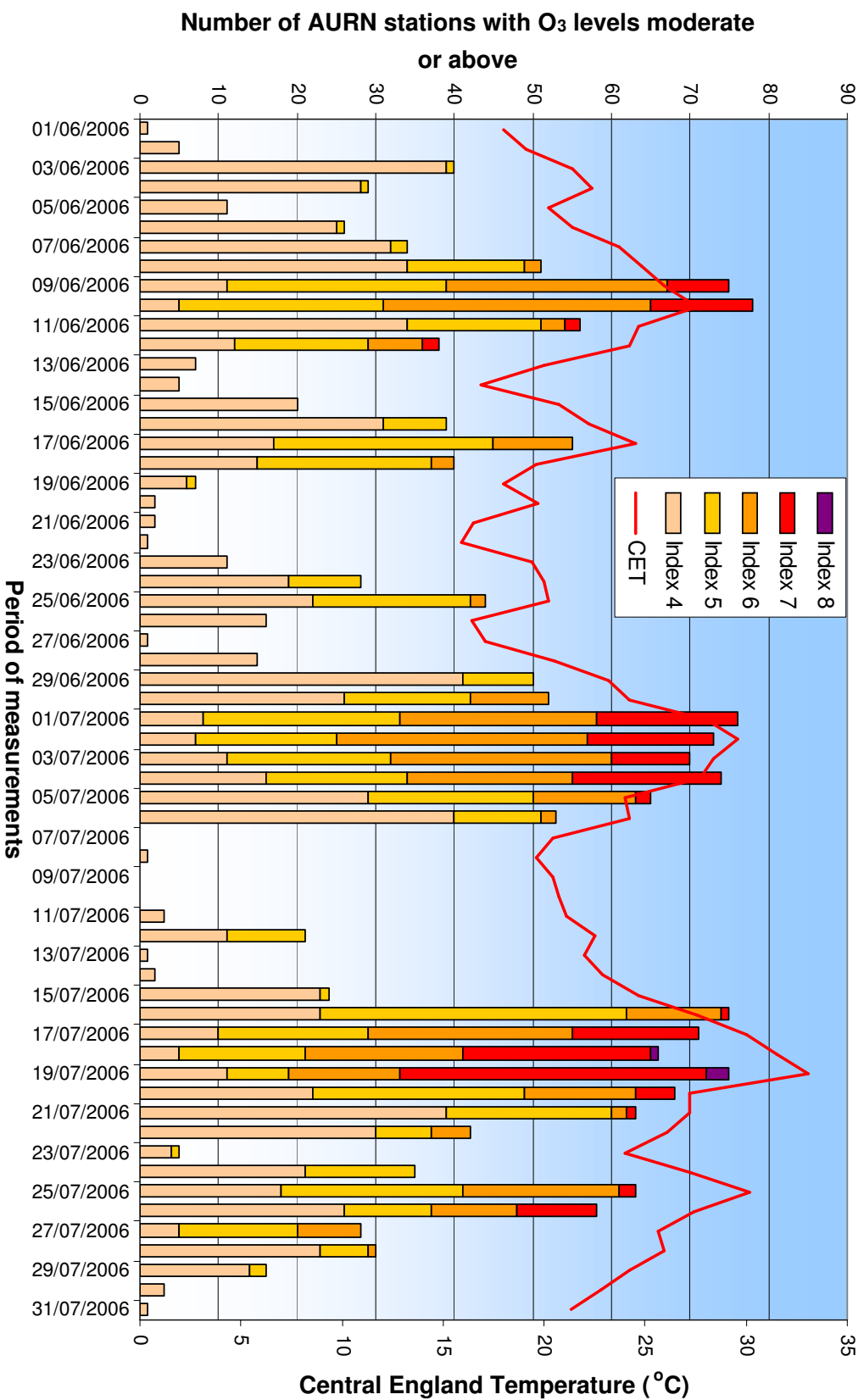
- Summer ozone episode over the UK are usually characterised by high temperatures and air masses re-circulating over northern Europe and the UK.
- The June and July 2006 ozone episodes are characterised by these two factors.

# Reasons for Ozone Episode - Temperature

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- 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

# Reasons for Ozone Episode - Temperature



# Reasons for Ozone Episode – Re-circulation

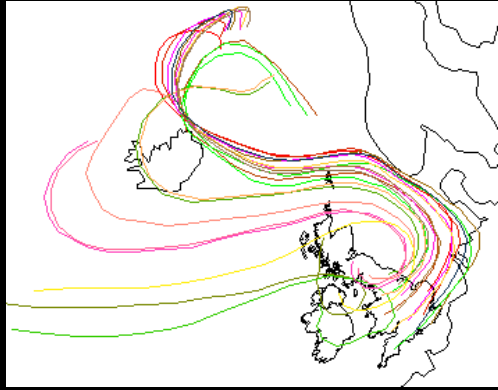
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- Despite the good agreement between high temperature and high ozone shown, the re-circulation of air masses over Europe and the UK need also to coincide.
- If high temperatures are not associated with air masses re-circulation, then the conditions 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.

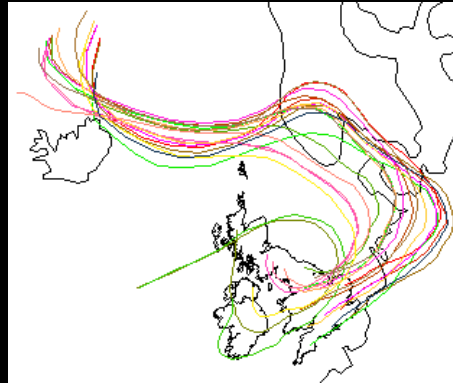


# Reasons for Ozone Episode – Re-circulation

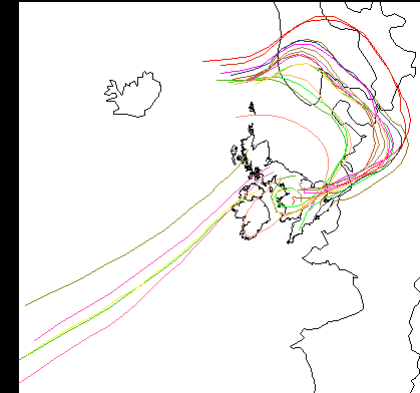
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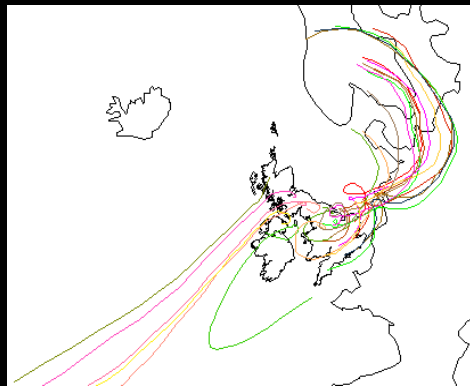
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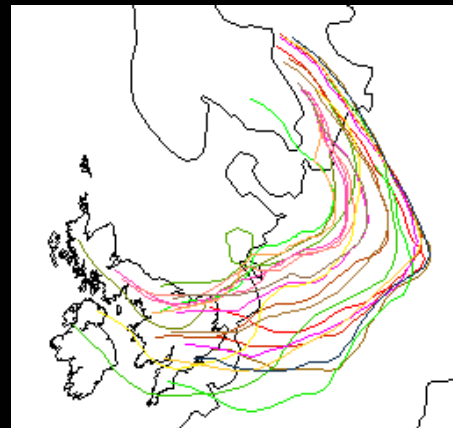
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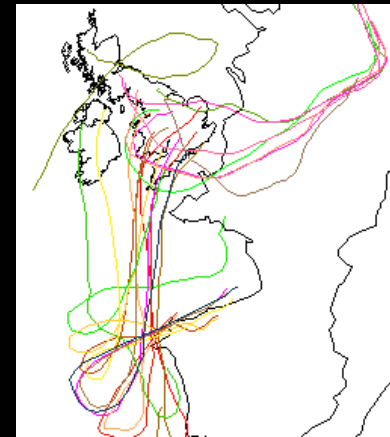
18/07/2006



19/07/2006



20/07/2006

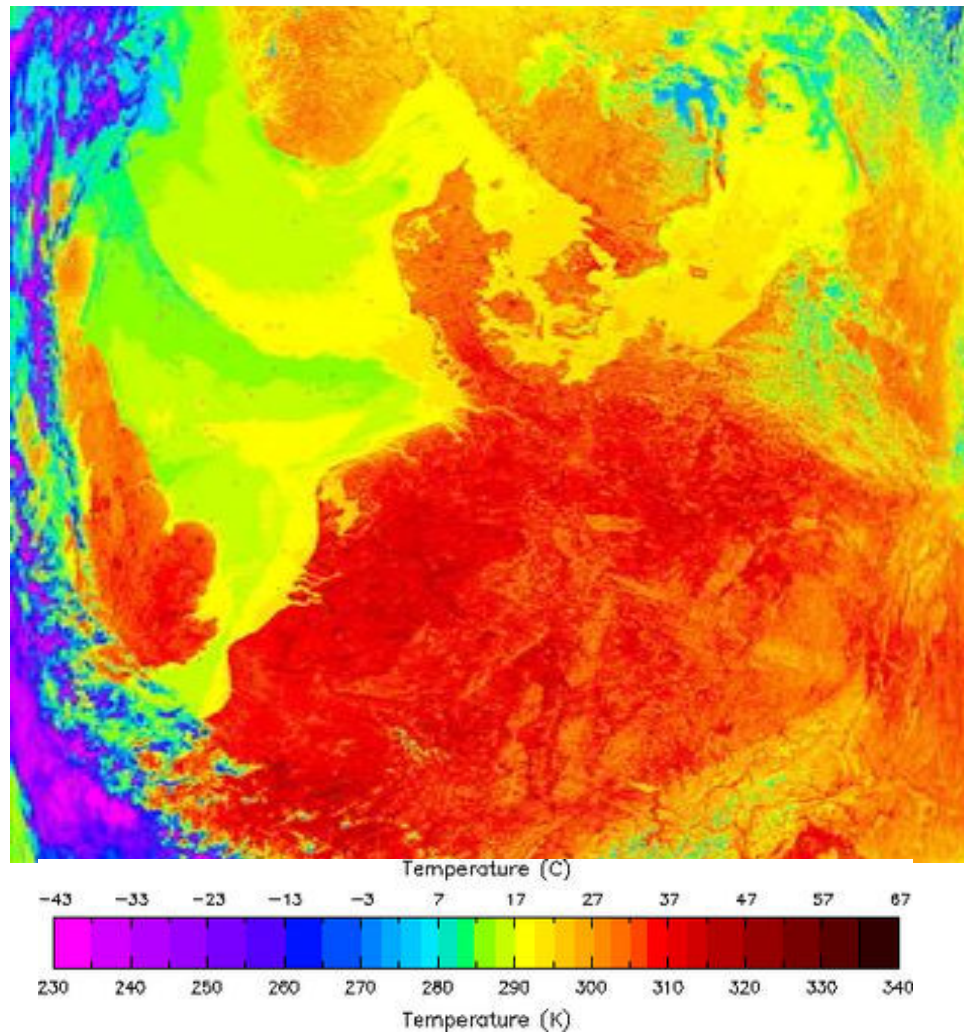


# Ozone Episode across Europe

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- 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.

# Ozone Episode across Europe



**Modis Satellite Image showing Temperature on 19<sup>th</sup> July 2006 at 10:35 UTC**

# Ozone Episode across Europe



Near real time provisional data

# Conclusions

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- 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.

# Conclusions

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- 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  $278 \mu\text{g m}^{-3}$  (index 8) on the 19th July at Wicken Fen at 18.00.
- 3rd Daughter Directive ozone alert threshold of  $240 \mu\text{g m}^{-3}$  was exceeded at Wicken Fen on 19th July, when 8 consecutive hours were measured above  $240 \mu\text{g m}^{-3}$  .
- This threshold was also exceeded at a non-AURN site, Lodsworth (Sussex Air) on 18th July.



# Thanks!

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- More information on:

Targa, J (2006) Air Pollution Forecasting: OZONE POLLUTION  
EPISODE REPORT (JUNE-JULY 2006) [in the Air Quality Archive!](#)