

# **Identification and selection of air pollution episodes for retrospective health studies**

**John Gulliver, David Briggs, Anna Hansell**

**Imperial College London**

[j.gulliver@imperial.ac.uk](mailto:j.gulliver@imperial.ac.uk)

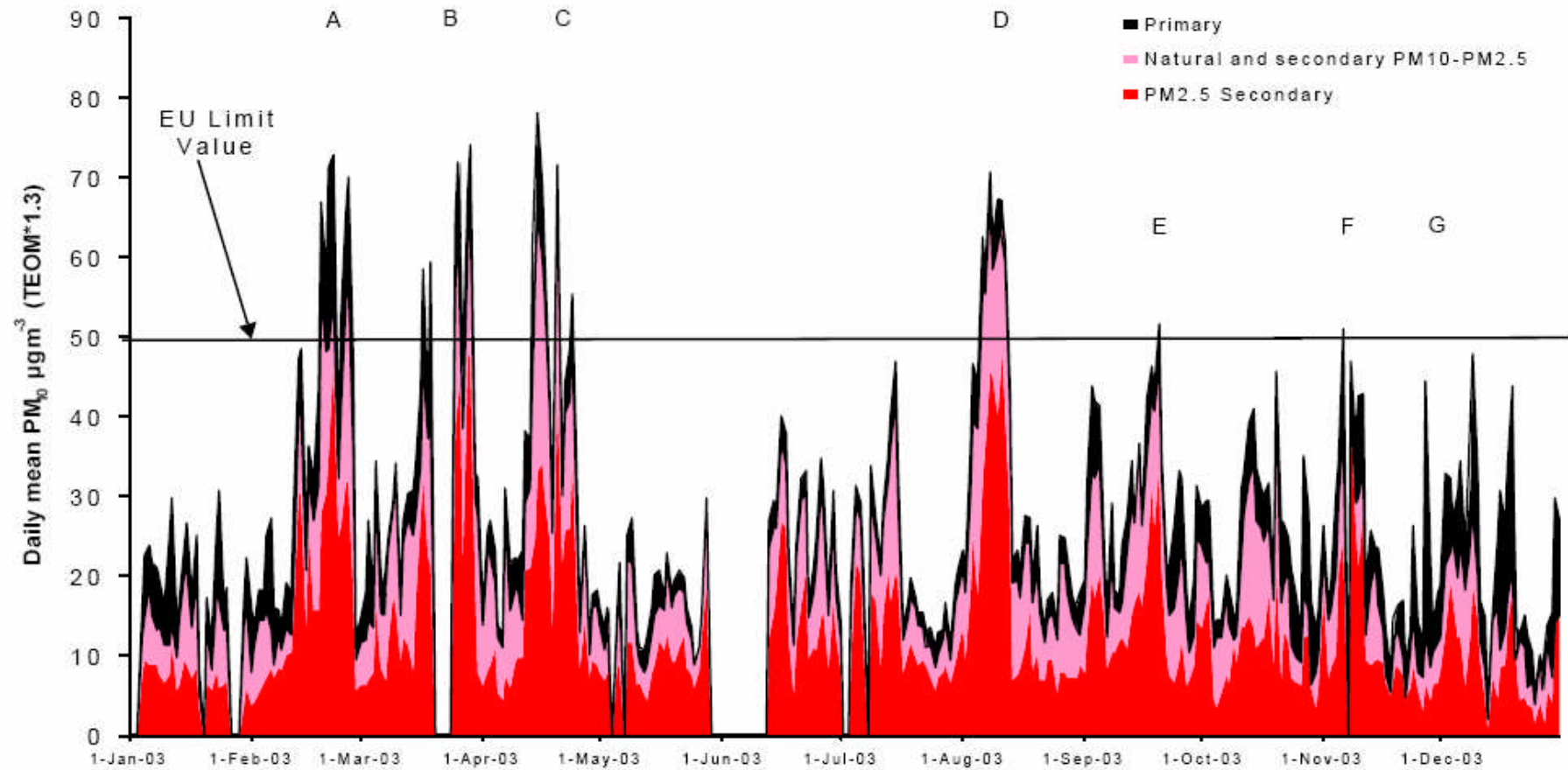
# GEMS health studies

1. Demonstrate the use of GEMS for retrospective health assessment via epidemiological analysis of air pollution episodes
2. As a basis for health risk assessment for policy support (using forecasting from GEMS models)
3. GEMS can also be used for health risk management and intervention (source emission limits; local sources - traffic management)

# Retrospective analysis

1. Joint study in UK and Ireland, focusing on:
  - Long-range air pollution (+local source contributions)
  - Acute effects of air pollution
  - PM<sub>10</sub> ( $\pm$  O<sub>3</sub>, NO<sub>2</sub>)
2. Selection of major long-range air pollution episode
  - PM<sub>10</sub> concentrations > 1SD above seasonal average?
  - Ca. 10 days +
  - Tracking across UK and Ireland
3. Selection of matched reference period
  - Same season
  - Same days of week
  - Same duration
  - 'No (significant) difference' temperature, windspeed /wind direction
  - >1 month before/after any episode

## Source apportionment of daily $PM_{10}$ at the inner London monitoring site at Kensington & Chelsea



Source: Environmental Research Group, King's College London

## 2003 Air Pollution Episodes

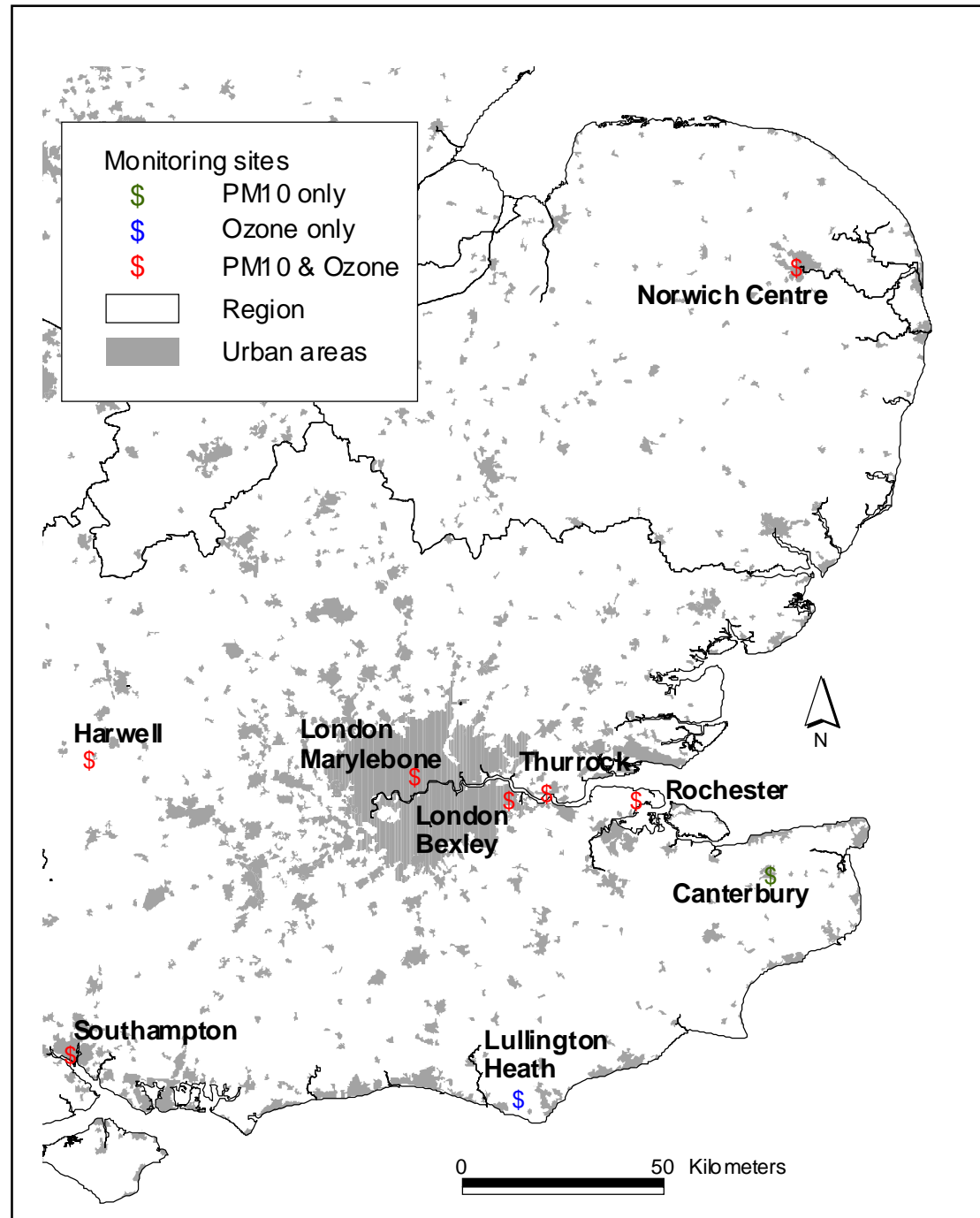
PM<sub>10</sub>: February, March, April, August

Ozone: an exceptionally long and hot summer with episodes in April, May, July, August

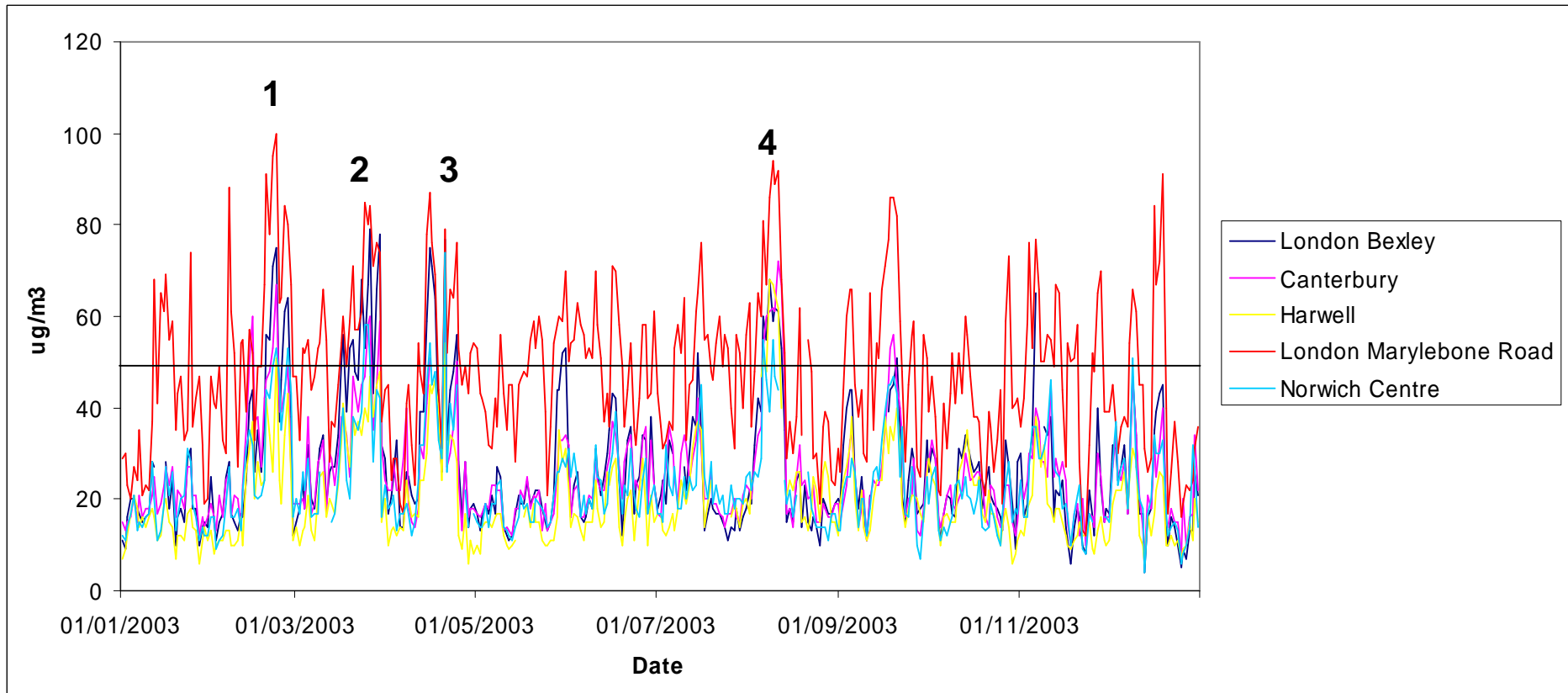
Nitrogen Dioxide - annual mean exceeded at many monitoring sites across UK

UK Air Quality Strategy (AQS) exceeded throughout London (N.B. at all kerbside and roadside sites) and South East

# UK air pollution (automatic) monitoring sites used in initial investigations



# PM10 (daily mean) episodes in 2003



1. 13<sup>th</sup> to 27<sup>th</sup> February (15 days)
2. 16<sup>th</sup> to 29<sup>th</sup> March (14 days)
3. 14<sup>th</sup> to 25<sup>th</sup> April (12 days)
4. 4<sup>th</sup> to 13<sup>th</sup> August (10 days)

AQS for daily mean PM10 = 50  $\mu\text{g}/\text{m}^3$

## PM10: Number of days above 50 ug/m<sup>3</sup> in 2003 (AQS)

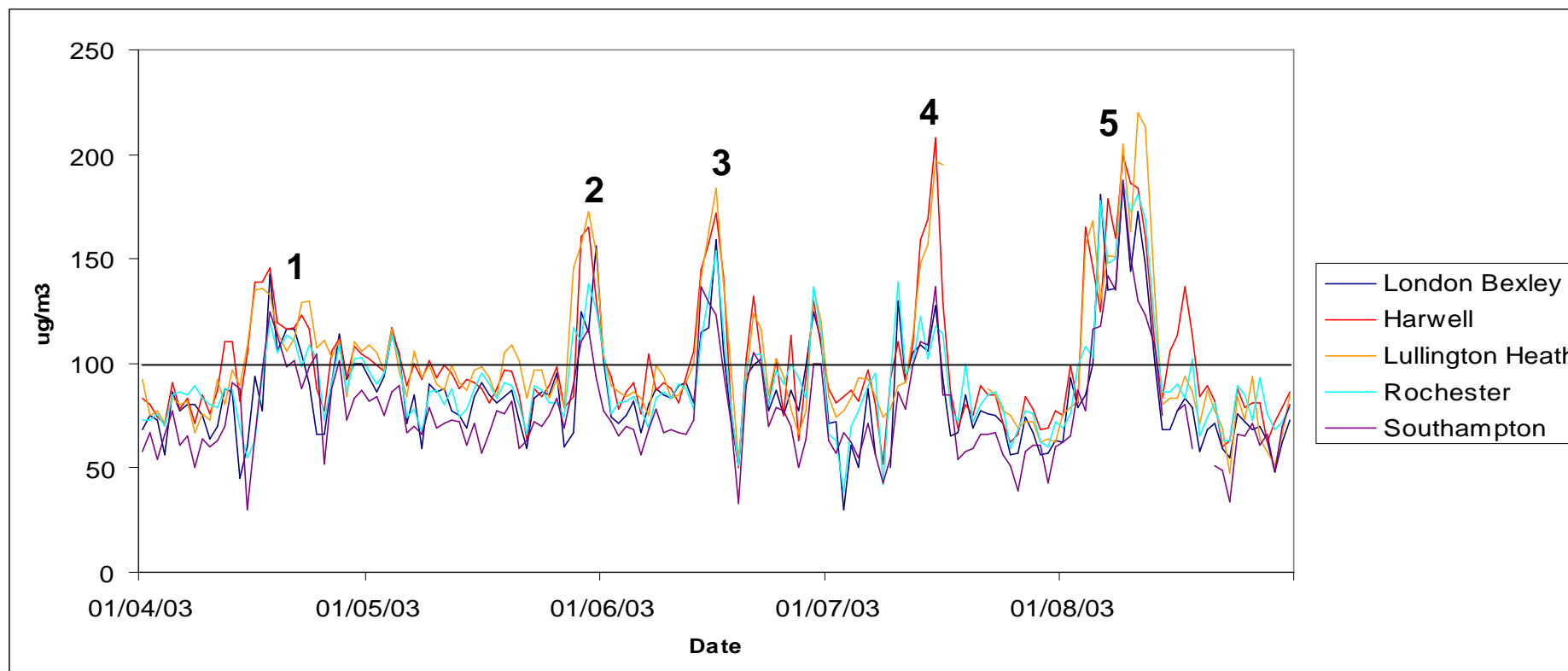
Site	Classification	13 – 27 Feb (15 days)	16 – 29 March (14 days)	4 – 13 August (10 days)
London Marylebone	Kerbside	12	13	10
London Bexley	Suburban	6	10	7
Thurrock	Urban Background	8	9	7
Canterbury	Urban Background	4	3	7
Norwich	Urban Centre	2	3	2
Harwell	Rural	1	0	5
Southampton	Urban Centre	1	8	na
Rochester	Rural	na	2*	7



## PM10: Number of days above the annual (2003) daily mean + 1 SD

Site	Classification	13 – 27 Feb (15 days)	16 – 29 March (14 days)	4 – 13 August (10 days)
London Marylebone	Kerbside	8	7	7
London Bexley	Suburban	8	13	8
Thurrock	Urban Background	9	9	7
Canterbury	Urban Background	12	11	8
Norwich	Urban Centre	10	11	6
Harwell	Rural	7	13	8
Southampton	Urban Centre	9	14	Na
Rochester	Rural	na	3*	8

# Ozone episodes : maximum daily 8-hour running mean (April – August 2003)



1. 15<sup>th</sup> April to 28<sup>th</sup> April (14 days)
2. 28<sup>th</sup> May to 1<sup>st</sup> June (5 days)
3. 13<sup>th</sup> June to 17<sup>th</sup> June (5 days)
4. 10<sup>th</sup> July to 16<sup>th</sup> July (7 days)
5. 3<sup>rd</sup> August to 13<sup>th</sup> August (11 days)

AQS for Ozone = 100  $\mu\text{g}/\text{m}^3$

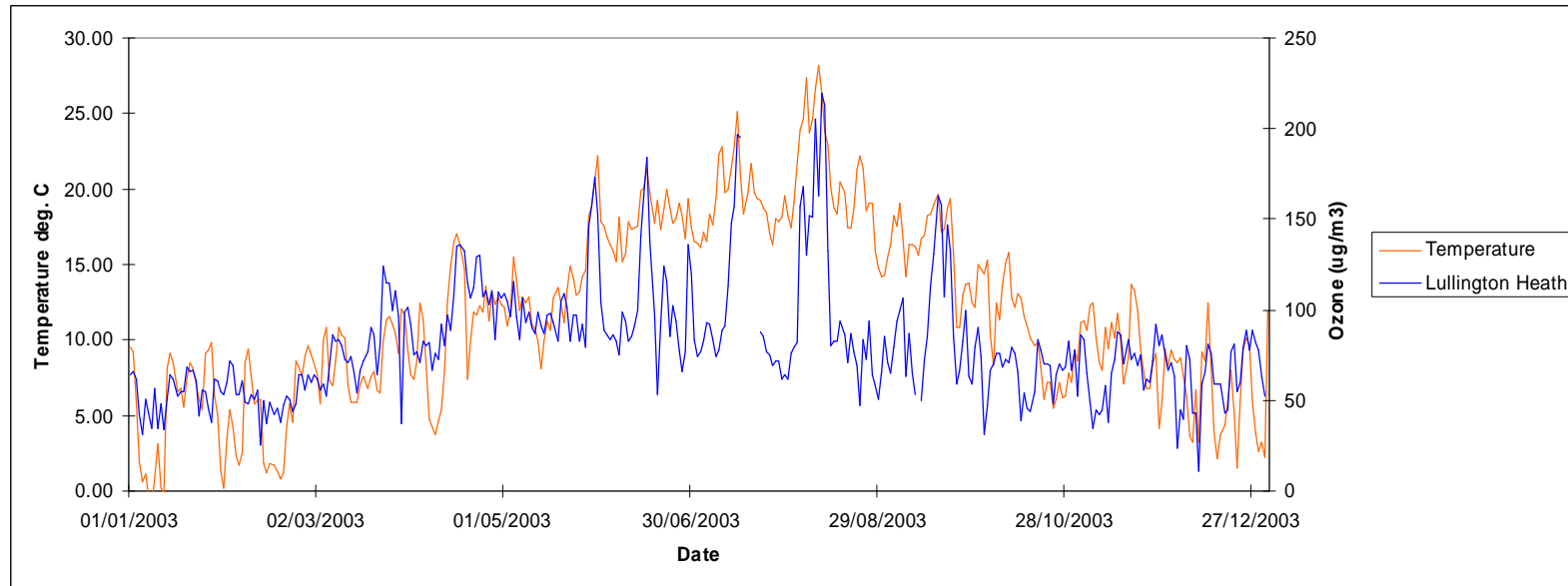
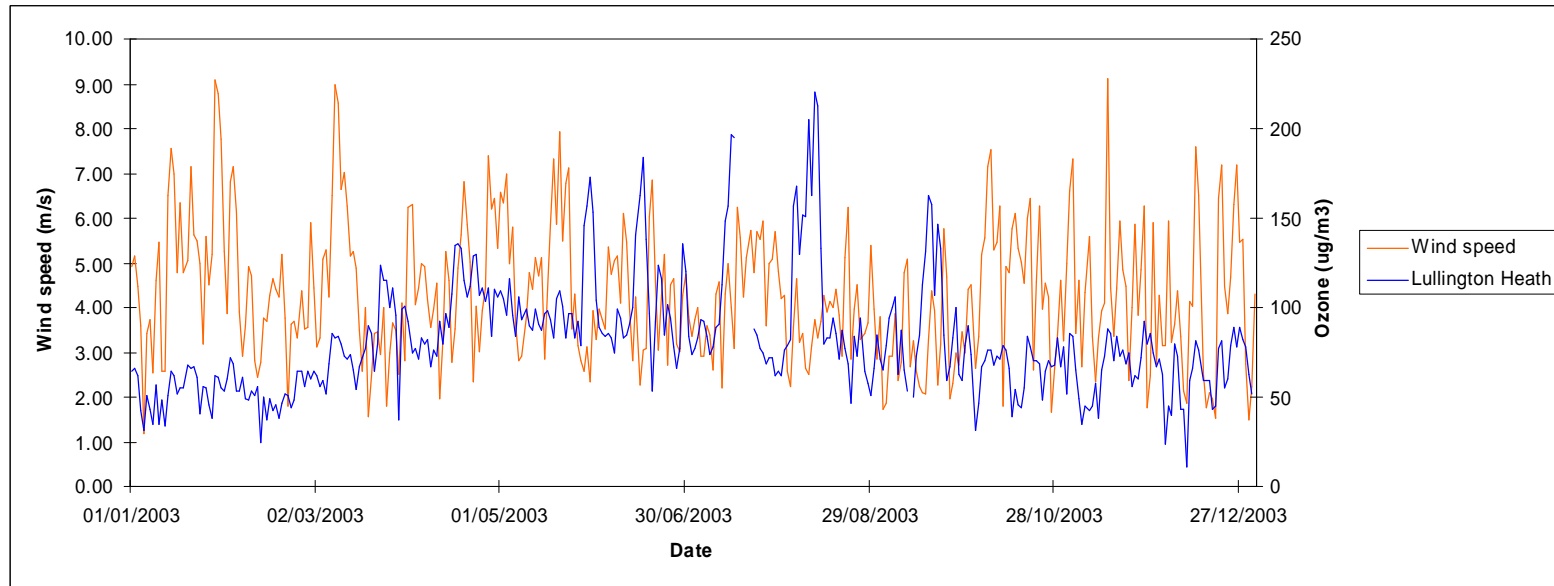
## Ozone: number of days above 100 ug/m<sup>3</sup> (8-hour running mean AQS)

Site	Classification	15 <sup>th</sup> – 28 <sup>th</sup> April (14 days)	13 <sup>th</sup> to 17 <sup>th</sup> June (5 days)	3 <sup>rd</sup> to 13 <sup>th</sup> August (11 days)
London Marylebone	Kerbside	1	1	1
London Bexley	Suburban	6	4	9
Thurrock	Urban Background	6	3	11
Lullington Heath	Rural	13	5	10
Norwich	Urban Centre	9	2	9
Harwell	Rural	11	5	10
Southampton	Urban Centre	5	3	9
Rochester	Rural	7	4	10

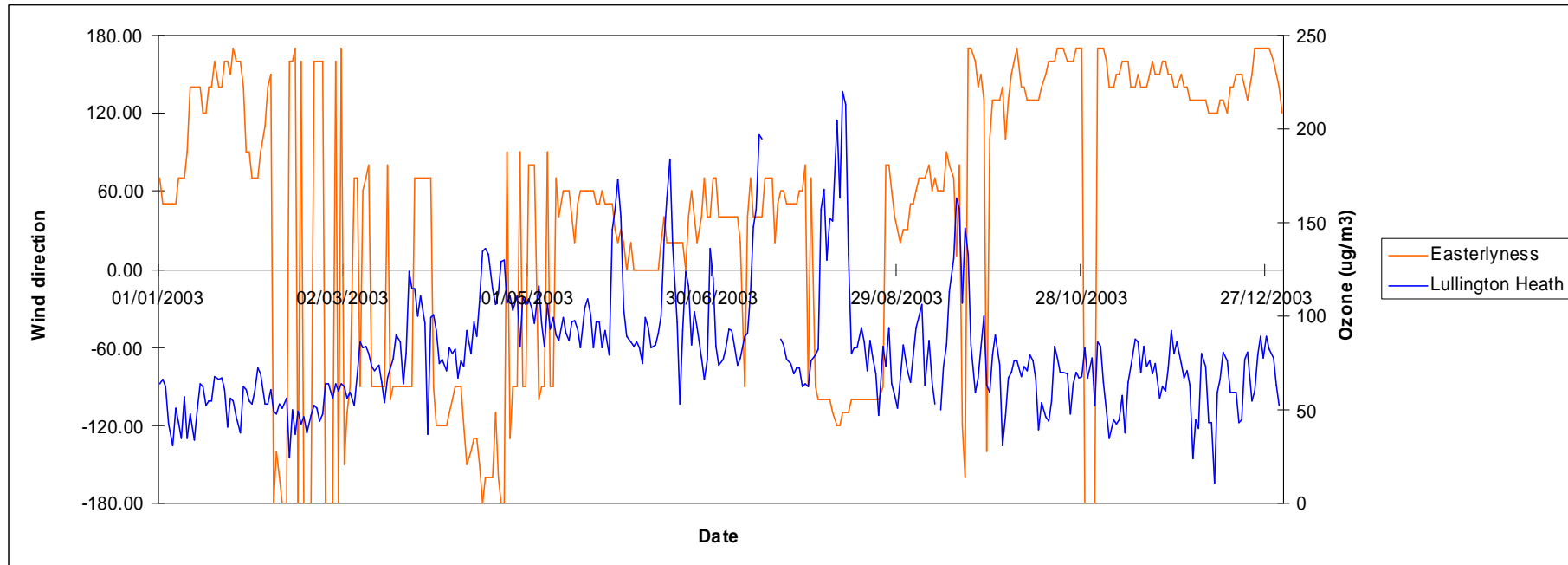
**Ozone: number of days above the seasonal mean  
(April 1<sup>st</sup> to Sept 30<sup>th</sup> 2003) + 1 SD**

Site	Classification	15 <sup>th</sup> – 28 <sup>th</sup> April (14 days)	13 <sup>th</sup> to 17 <sup>th</sup> June (5 days)	3 <sup>rd</sup> to 13 <sup>th</sup> August (11 days)
London Marylebone	Kerbside	3	1	6
London Bexley	Suburban	4	3	7
Thurrock	Urban Background	2	4	9
Lullington Heath	Rural	3	3	9
Norwich	Urban Centre	8	4	8
Harwell	Rural	3	4	8
Southampton	Urban Centre	5	2	9
Rochester	Rural	1	3	8

# Meteorological patterns during 2003 Ozone episodes

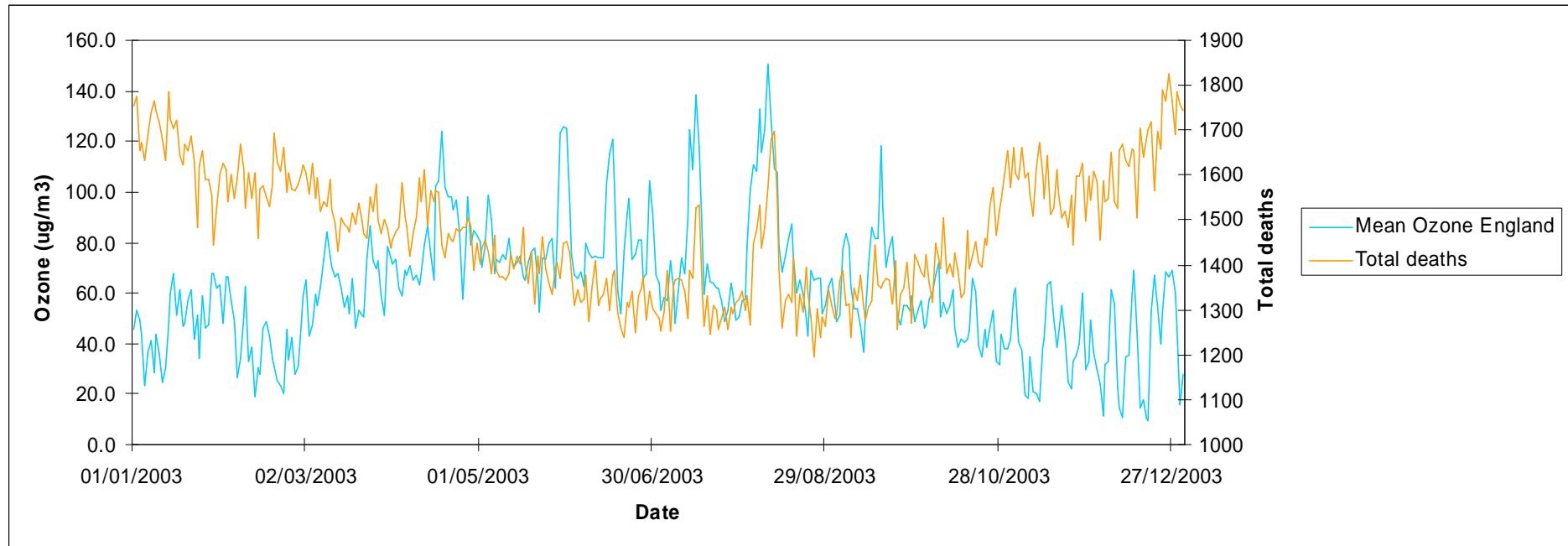


## Rural daily mean ozone from a rural monitoring site and “easterlyness” of wind

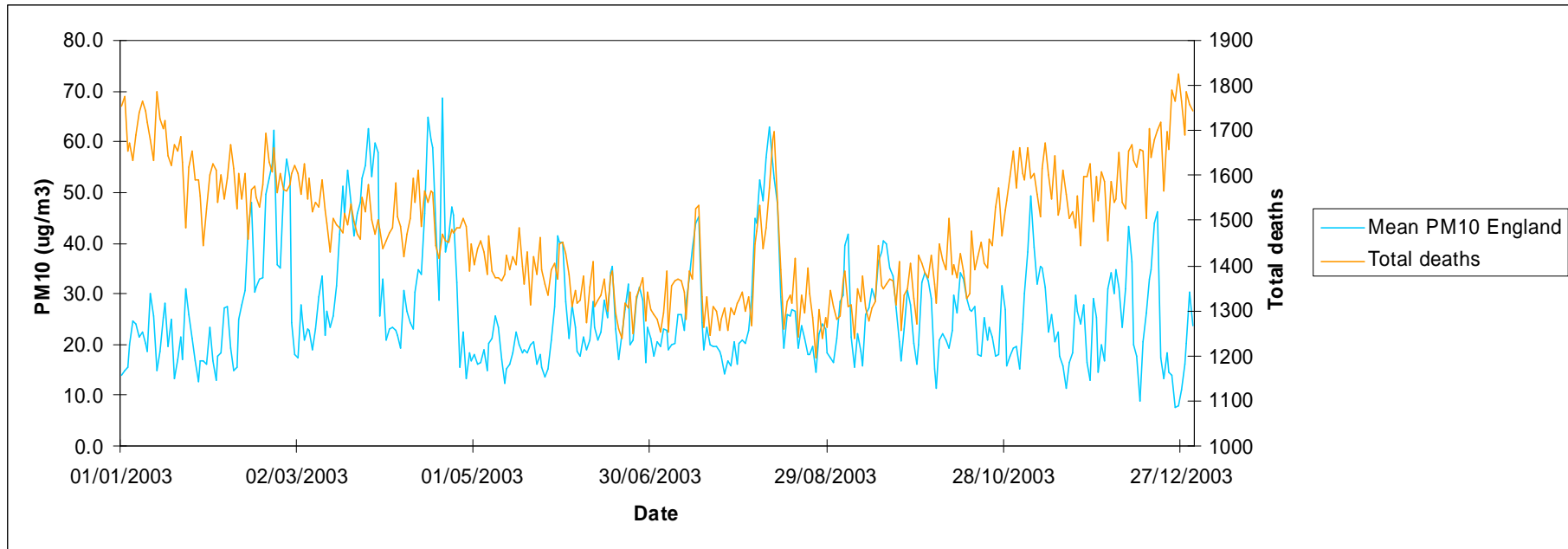


N.B. Wind direction: 0 to +180 deg. clockwise from east  
0 to -180 deg. anticlockwise from east

# Total daily deaths in England & Wales against the average of daily mean ozone from all monitoring sites in England (2003)

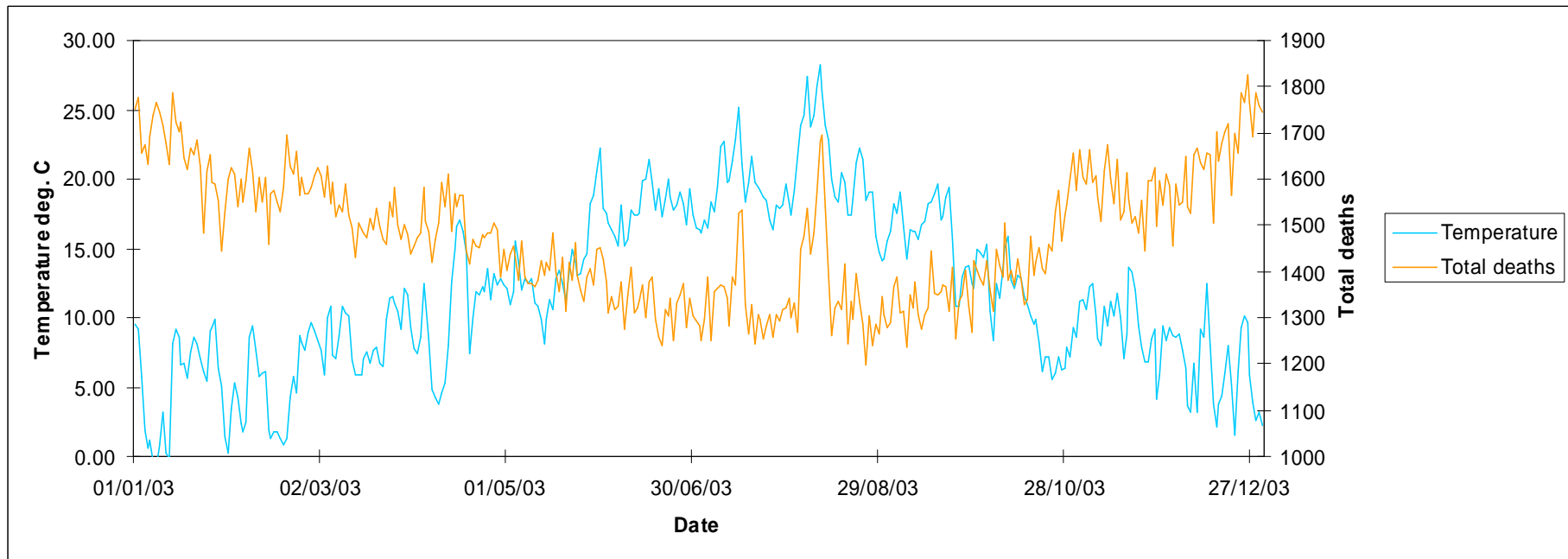


## Total daily deaths in England and Wales against the average daily mean PM<sub>10</sub> from all monitoring sites in England (2003)





## Daily mean temperature from London Heathrow Against total daily deaths for England & Wales (2003)

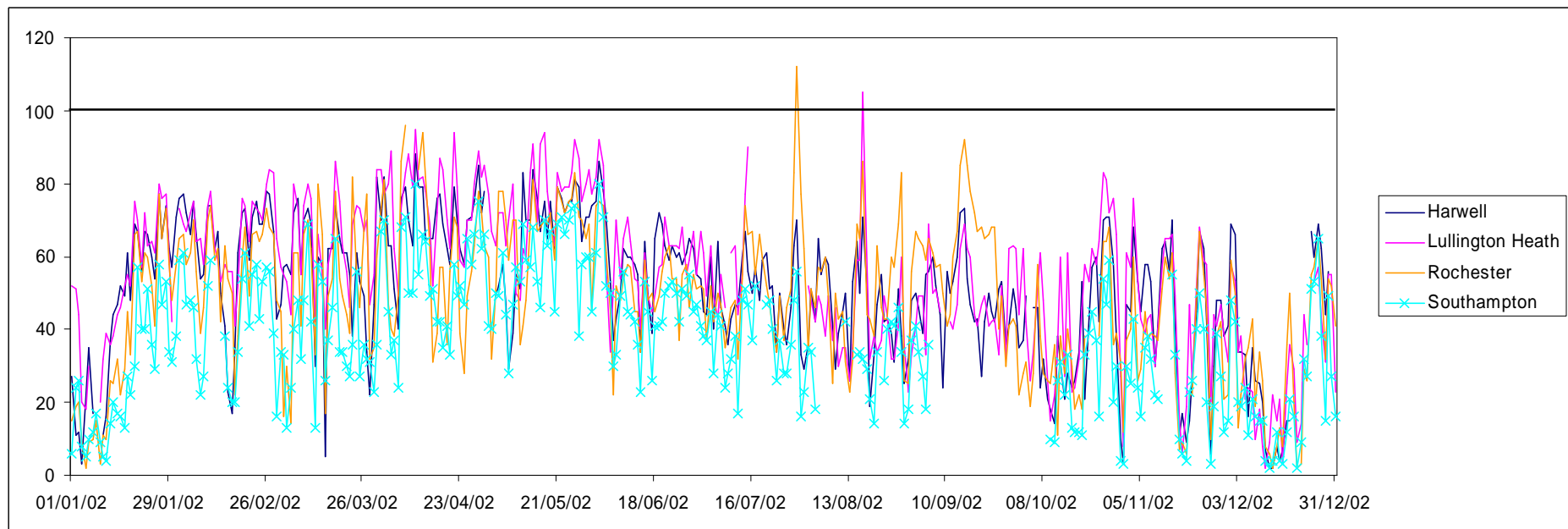


## **Selection of matched reference periods**

Reference periods likely to be selected from 2002:

- Same season
- Same days of week
- Same duration
- 'No difference' temperature, windspeed
- >1 month before/after any episode

# Ozone: maximum daily 8-hour running mean (2002)



AQN for Ozone = 100  $\mu\text{g}/\text{m}^3$