

## Implications for the assessment of EU Limit Values when changing from TEOM to reference equivalent PM<sub>10</sub> measurements

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- Network measurements
- Co-location measurements from 2004-2006
- Measurements from AURN 2007 corrected using VCM
- Modelling work in London incorporates VCM

Summary

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## Background

Regulatory requirement to monitor PM<sub>10</sub>

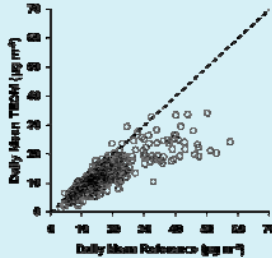
- Disseminate to public

Reference method

- Poor time resolution, slow dissemination, expensive.

TEOM used widely in the UK

- Measures a lower concentration than the reference due to heated sample stream.
- Cannot be made equivalent with simple correction factors.



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## Geographical and temporal variation in differences

Due to:

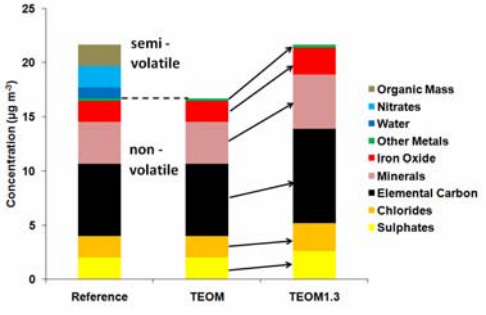
- Chemical composition
- Meteorological conditions

Single linear factor will not work due to:

- Relative contribution of semi-volatile PM
- SVPM is a daily concentration over a wide area rather than percentage of mass
- Varies geographically and temporally

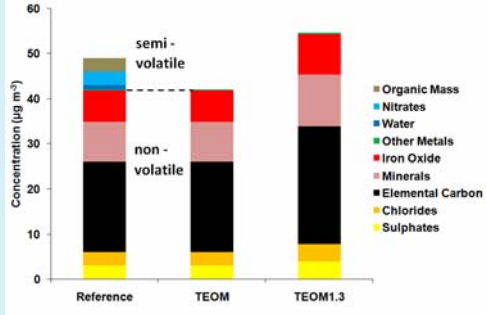
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## Effect of correction factor on chemical composition



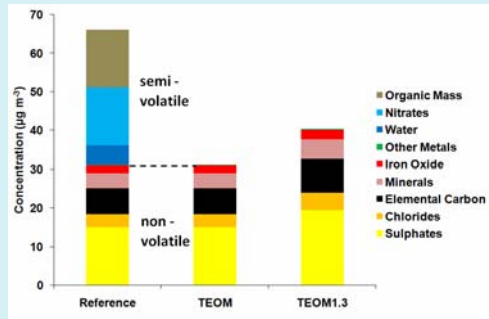
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## High primary non – volatile PM



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## High secondary semi – volatile PM



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## Methods

### Measurement methods

- TEOM measurements multiplied by 1.3
- FDMS
  - Network QA/QC ( $K_0$ , flow and leak checks)
- KFG – Leckel Kleinfiltergerät PNS-X8 reference sampler
  - Operated as part of UK PM equivalence trial
  - Emfab filters
  - Weighed by NPL according to EN14907

### Uncertainty

- Expanded uncertainty at  $k=2$  calculated using GUM methodology, e.g. EN14907

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## UK National Network Results

### TEOMs upgrade to FDMS

- 21 urban background sites Spring 2007
- Remainder of network autumn 2008 to Spring 2009

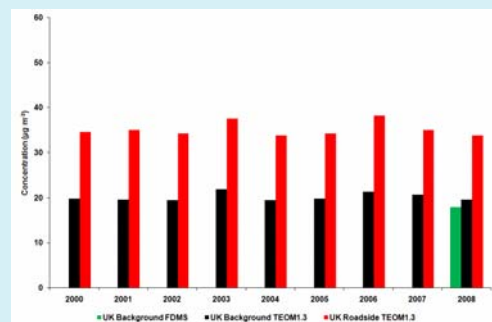
### Limited data to assess implications

- Lack of complete years
- Most sites did not meet 75% data capture quality objectives for either 2007 or 2008
- Urban background sites upgraded in 2007, no roadside sites

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## UK Annual Mean PM<sub>10</sub>

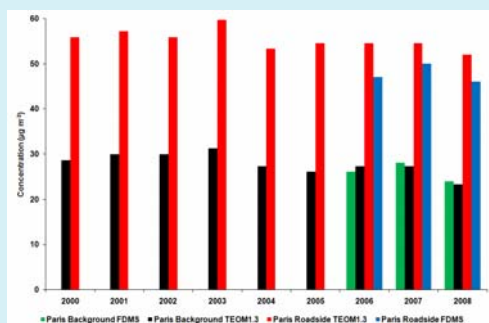


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## Paris Annual Mean PM<sub>10</sub>

(supplied by Karine Leger, AirParif)



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## Co-located measurements 2004-2006

### UK PM Equivalence programme

- 4 sites with KFG, TEOM and FDMS
- Approx 4 months sampling at each site

### London Air Quality Network

- 5 sites with TEOM and FDMS (plus Teddington)
- Between 3 and 24 months sampling

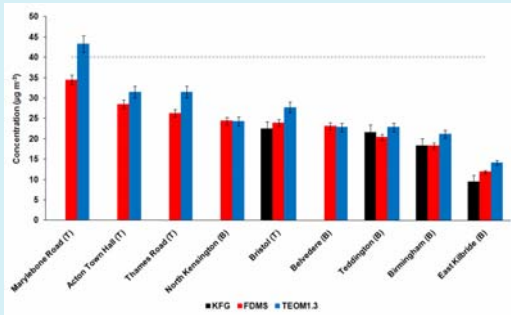
### Data capture issues

- Annual Daily Means  $>50 \mu\text{g m}^{-3}$  = Daily Means  $>50 \mu\text{g m}^{-3}$  / Data Capture (%)

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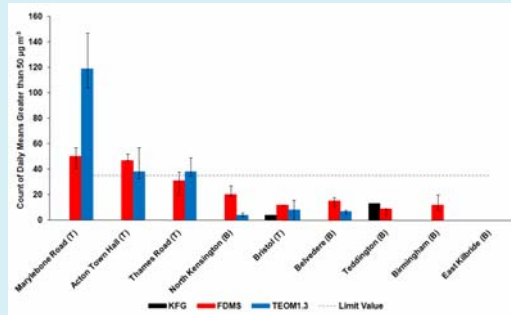
## Mean concentrations



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## Daily mean concentrations greater than 50 µg m<sup>-3</sup> per year



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## UK wide measurements

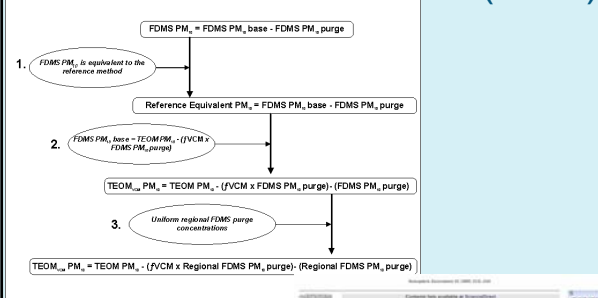
Three daily mean sets from 2007 were compared to the limit values:

- 25 TEOMs on the AURN, which were not upgraded to FDMS instruments in the spring of 2007, were corrected using the VCM.
- AURN TEOMs were also adjusted using the 1.3 correction factor.
- The co-located FDMS measurements from North Kensington.

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## Volatile Correction Model (VCM)

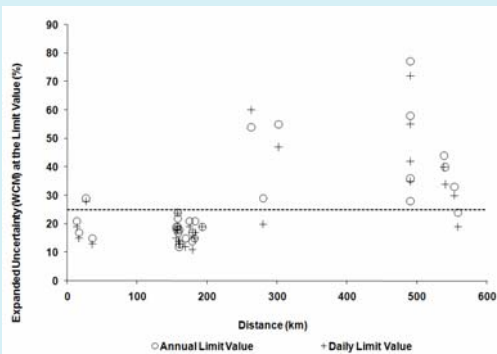


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Development and validation of the volatile correction model for PM<sub>10</sub> - An empirical method for adjusting TEOM measurements for their loss of volatile particulate matter

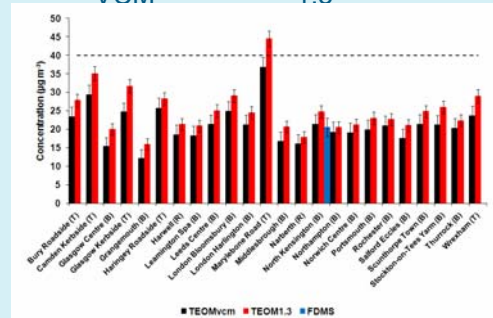
## VCM Equivalence testing



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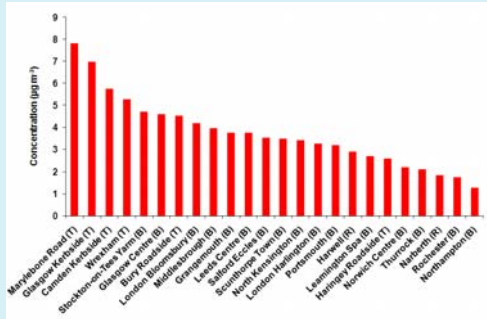
## Annual mean concentrations of TEOM<sub>VCM</sub>, TEOM<sub>1.3</sub> and FDMS



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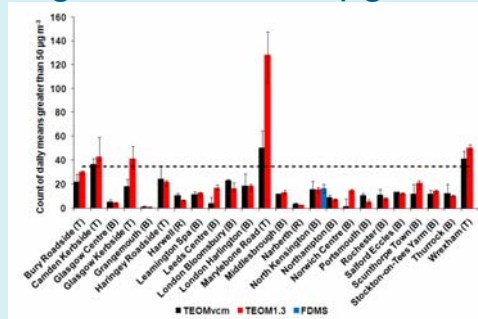
## TEOM<sub>1,3</sub> - TEOM<sub>VCM</sub> annual mean concentrations



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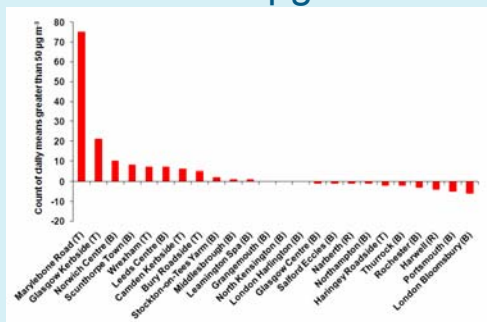
## Daily mean concentrations greater than 50 µg m<sup>-3</sup>



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## TEOM<sub>1,3</sub> - TEOM<sub>VCM</sub> greater than 50 µg m<sup>-3</sup>



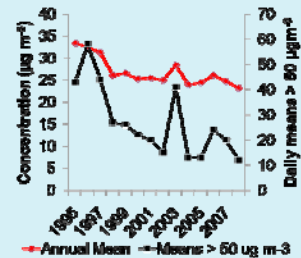
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## Inter-annual variability

Demonstrated good agreement between 2004-6 period and 2007

- 'Normal' years
- What about 2003?



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## Alterations to VCM methodology

FDMS measurements started in late 2003  
2003 VCM correction derived from other measurement

- FDMS purge measurements
- Real time ammonium nitrate
- Difference between TEOM and reference measurements

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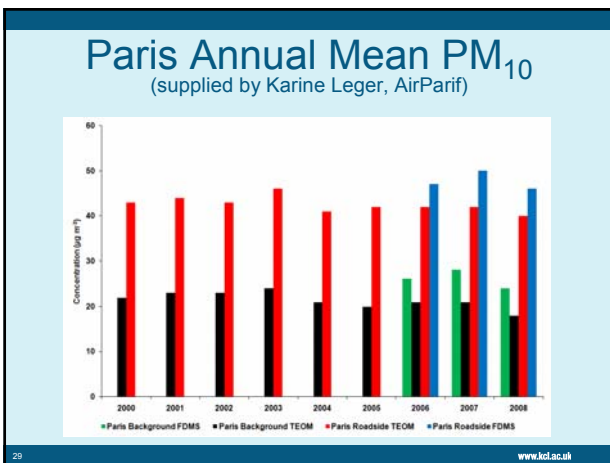
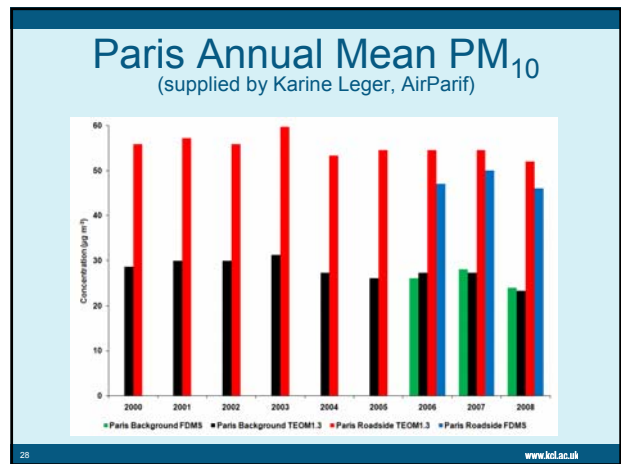
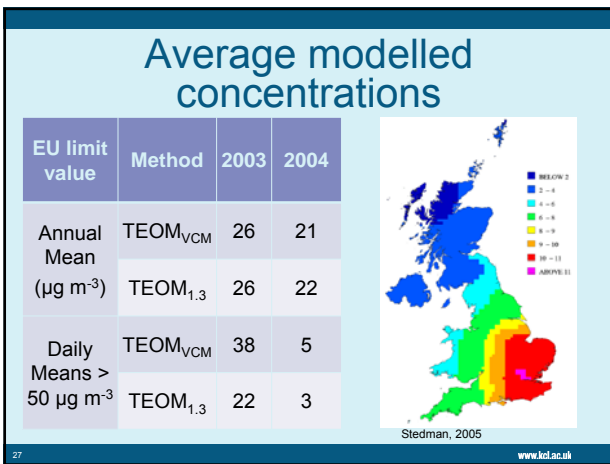
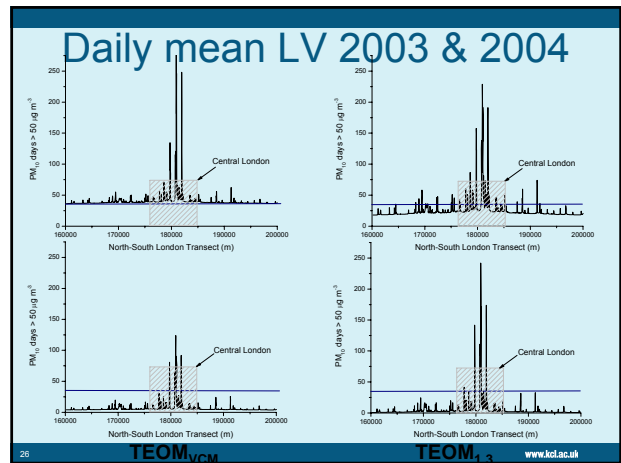
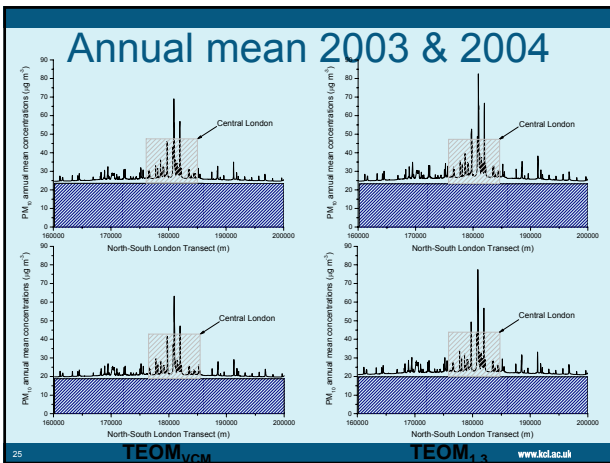
## Modelling methodology

- Kernel modelling technique
- Each kernel created from hourly met data
- Set of model concentration fields produced using point sources, volume sources or road sources
- Concentration fields adjusted for source strength based on London atmospheric emissions inventory



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### Summary 1

Limited measurements to assess impact from current measurements in UK

Other datasets demonstrate a consistent picture:

- Paris network (AirParif)
- UK equivalence trials
- London network (LAQN)
- VCM

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## Summary 2

Reduction in breaches of the limit values during 'normal' years at most sites.

- Annual LV breached at:
  - Heavily trafficked locations in central London
- Daily LV breached additionally at:
  - Roadside sites in London and heavily trafficked roadside sites outside London

Consistent with UK PM<sub>10</sub> TEN

Air quality management

- Continue to tackle with a mix of international, national, regional and local abatement measures

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## Summary 3

During years such as 2003 widespread areas of the south east UK likely to breach daily mean LV

Different challenge for air quality management

- Local and national abatement will not impact on long range transport episodes
- Requires reduction in precursor emissions of VOCs, NO<sub>x</sub>, SO<sub>2</sub> and NH<sub>3</sub>

Choice of correction factor has led UK and France to view the same problems from opposite sides

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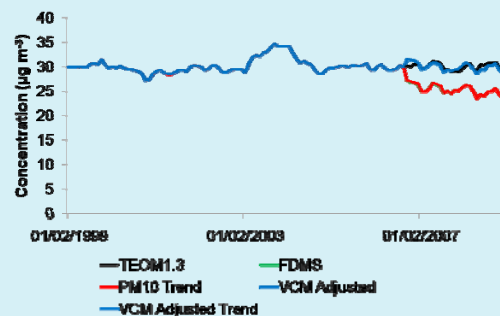
## Discontinuity in trends

How do we assess the impact of abatement strategies when there is a step change in the measurements?

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## Discontinuity in trends – VCM in reverse?



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## Acknowledgements

VCM development

- Gary Fuller and Tim Baker

Modelling results

- Sean Beevers, David Dajnak and Emily Westmoreland

Funding

- Defra and the Devolved Administrations, Local authorities in London (Westminster, Kensington & Chelsea, Bexley, Ealing and Greenwich)

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