London's approach to preventing air pollution episodes

Ben Barratt, King's College London

Expert Meeting on Improving Air Quality in the Beijing-Tianjin-Hebei Region

4 June 2013

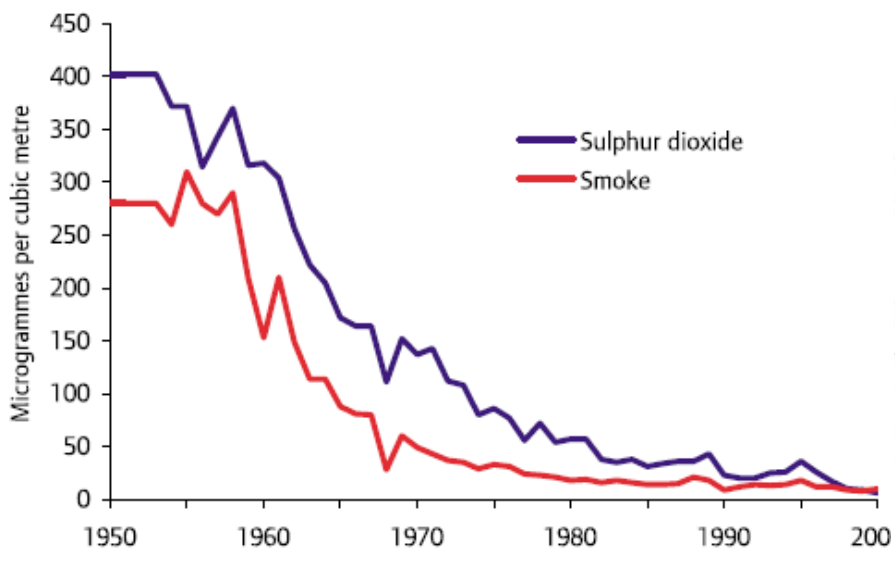
KING'S College LONDON

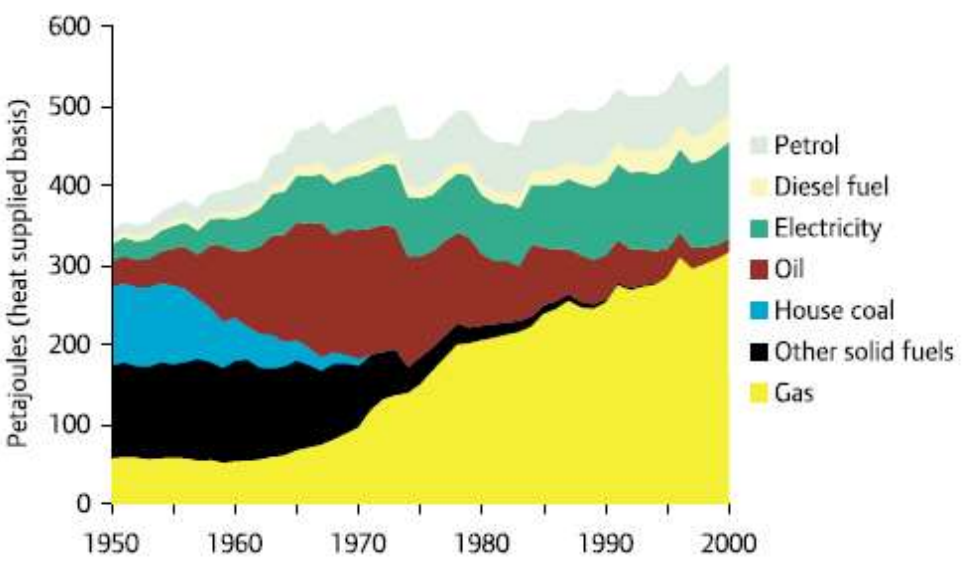
Presentation outline

- A brief introduction to air quality management in the UK
- London's approach to preventing air pollution episodes
- Management of PM in London by source apportionment
- Transferring London's experience to the Beijing-Tianjin-Hebei Region

Emergency response to the 'great London smogs' of the 1950s

- Ban on house coal produced an immediate effect
- Followed by relocation of power generation to rural areas
- Then dominance of domestic and industrial gas from 1970





Source: Greater London Authority, 2002

Fuel controls – more successes

- Lead in fuel
- Low and ultra low sulphur fuel (SO_2 and particle number)
- Both led to a dramatic stepped decrease in concentrations.

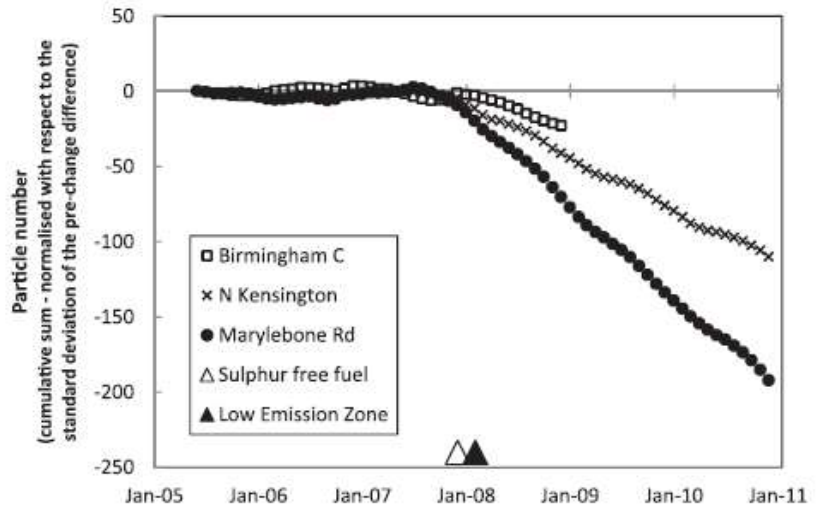


Fig. 3. Normalised monthly cumulative sums of particle number concentration difference. Triangles indicate the introduction of sulphur-free diesel and the LEZ respectively.

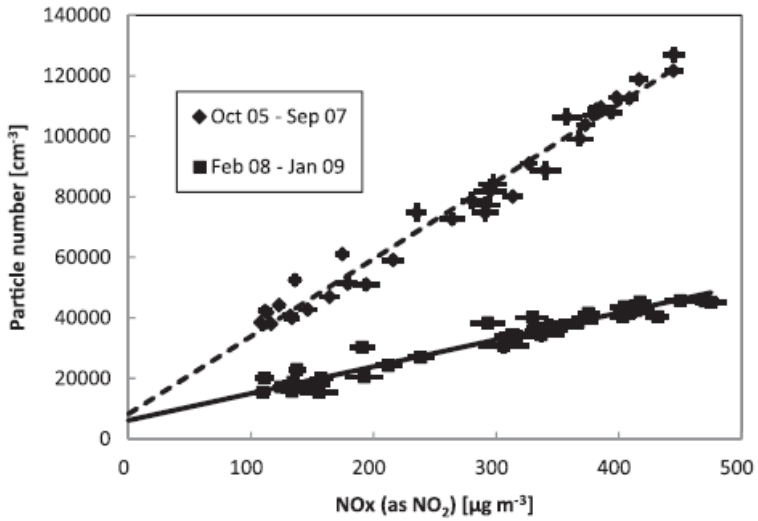


Fig. 5. Marylebone Road - particle number v NO_x at 10^0 wind sectors.

UK's Response to 'modern' air pollution

- A decline in UK heavy industry and cleaner power generation methods has shifted emphasis to vehicular emissions.
- National policy dependant on staged tightening of EU emissions ceilings and new vehicle 'Euro' standards.
- The whole of the UK is now compliant with SO_2, benzene, lead and CO air quality standards.
- Early successes with exhaust emissions control technology (CO, NO_X, SO_2) have stalled and problems remain in relation to NO_2, PM_{10} and $PM_{2.5}$ in urban pollution 'hotspots'.
- Local authorities are responsible for 'hotspot' identification and remediation.

London's response to pollution hotspots and episodes

- On-going appraisal of pollution sources and distribution using dense monitoring network, detailed emissions inventories and urban modelling.
- Scenario testing and identification of most cost effective solutions for each pollutant and location.
- $PM_{2.5}$ standard is based on 'exposure reduction', i.e., population weighted change over time.
- No specific legislation for 'emergency response' during episodes. Response limited to public forecasts, information and advice on how to avoid health impacts.

London's response to pollution hotspots and episodes

- Traffic management – Congestion Charging Scheme
- Accelerating vehicle fleet turnover – Low Emission Zone, emissions control of bus and taxi contracts.
- Financial incentives – road, parking and fuel tax, scrappage scheme.
- 'Clean-up' solutions – TiO_2, dust suppressants, green walls.
- Social solutions – public awareness, education and information.

The London Congestion Charging Scheme (2003)

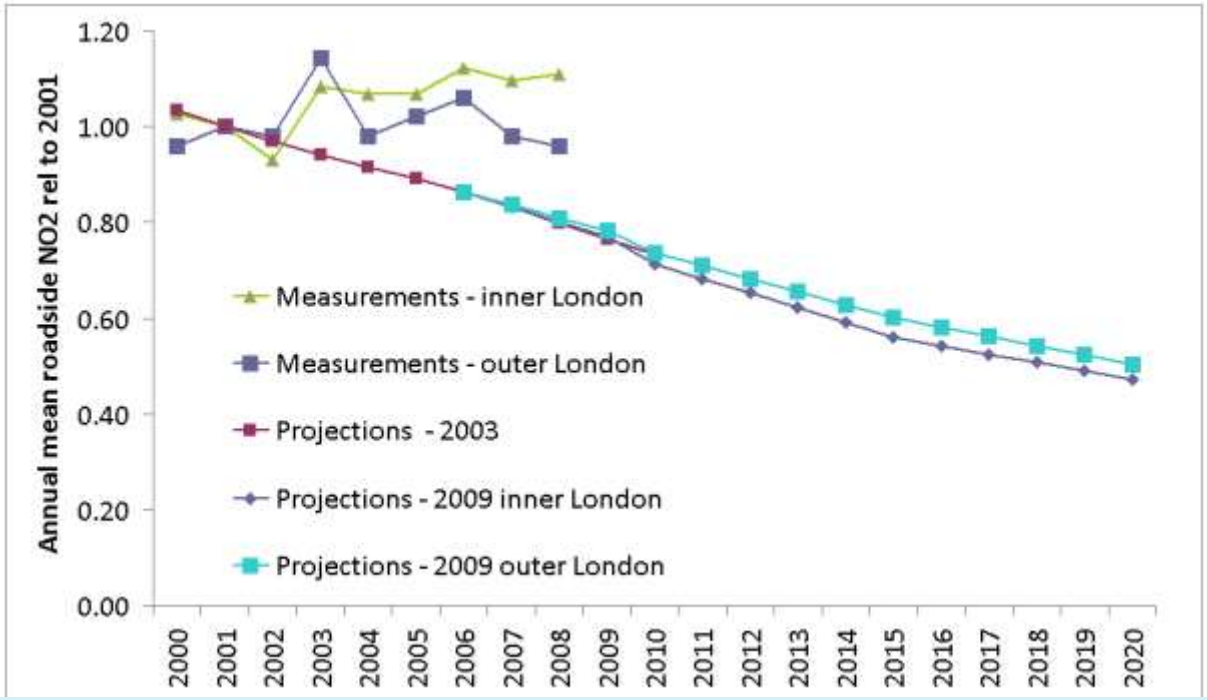
- Payment scheme introduced to cut levels of traffic in central London, not an environmental initiative.
- Sustained immediate drop in vehicle numbers.
- Little impact on air quality due to small area covered (22 km^2, 14%) and a shift to diesel fuelled public transport.
- Decrease in NO, but increase in roadside NO_2 due to introduction of regenerating particle traps on buses.
- Western Extension removed with a change in Mayor.

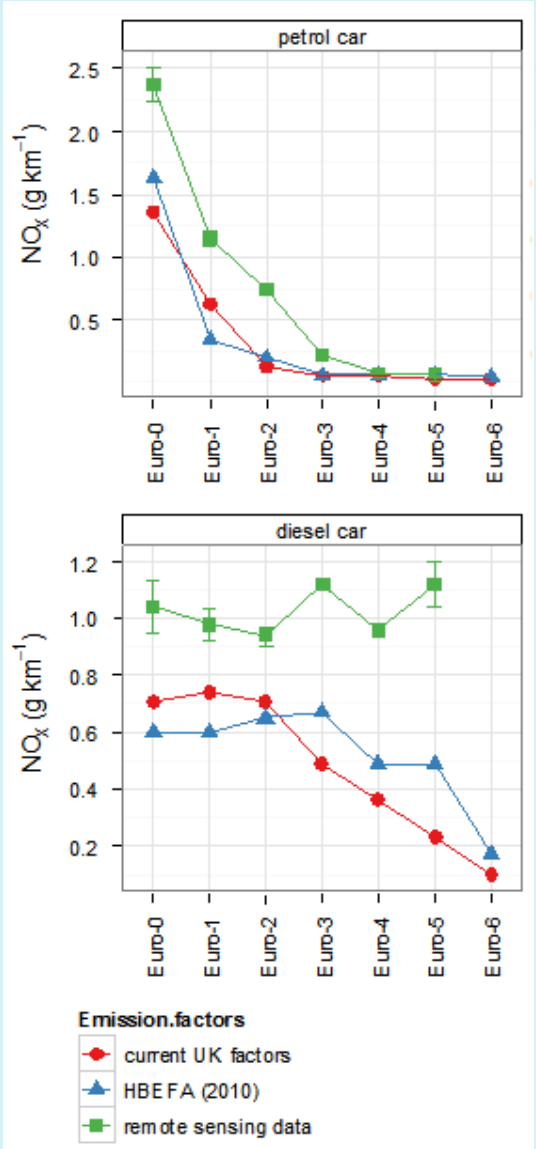
The London Low Emission Zone (2008)

- The primary aim was to reduce PM_{10} by targeting the most heavily polluting diesel vehicles.
- Largest LEZ in the world - covers an area of 2644 km^2 in which more than 8 million people reside.
- Four phases to date with increasing fleet coverage and stricter Euro emissions standards (HGV Euro IV, LGV Euro III).
- Compliance rates > 90%.
- 15% / 1 µg m^{-3} per year decrease in concentrations of black carbon and non-regional $PM_{2.5}$ at roadside locations (2006-9).
- No measurable LEZ-related impact on primary PM_{10} found.

Exhaust emissions control

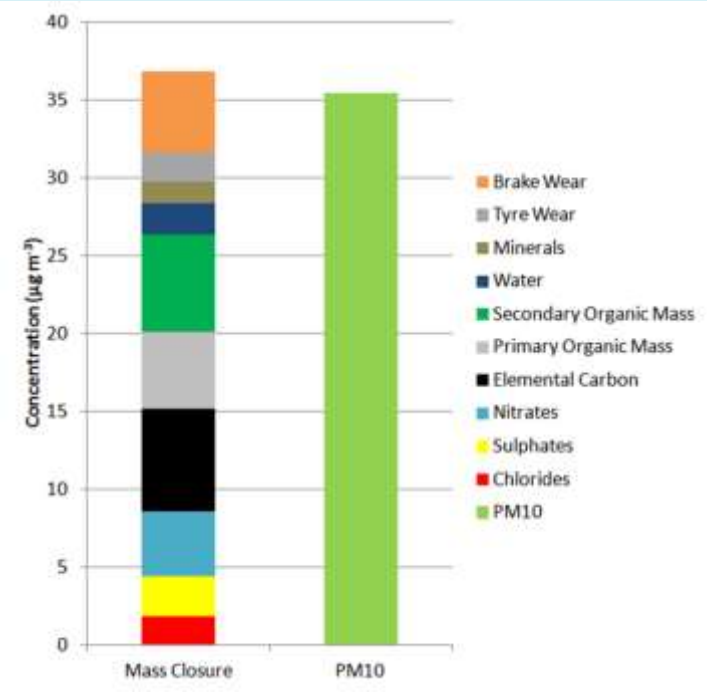
- Euro standards have not been delivering the expected improvements over past 10 years.
- Increased market share of diesel.
- Emissions testing not reflecting real world.



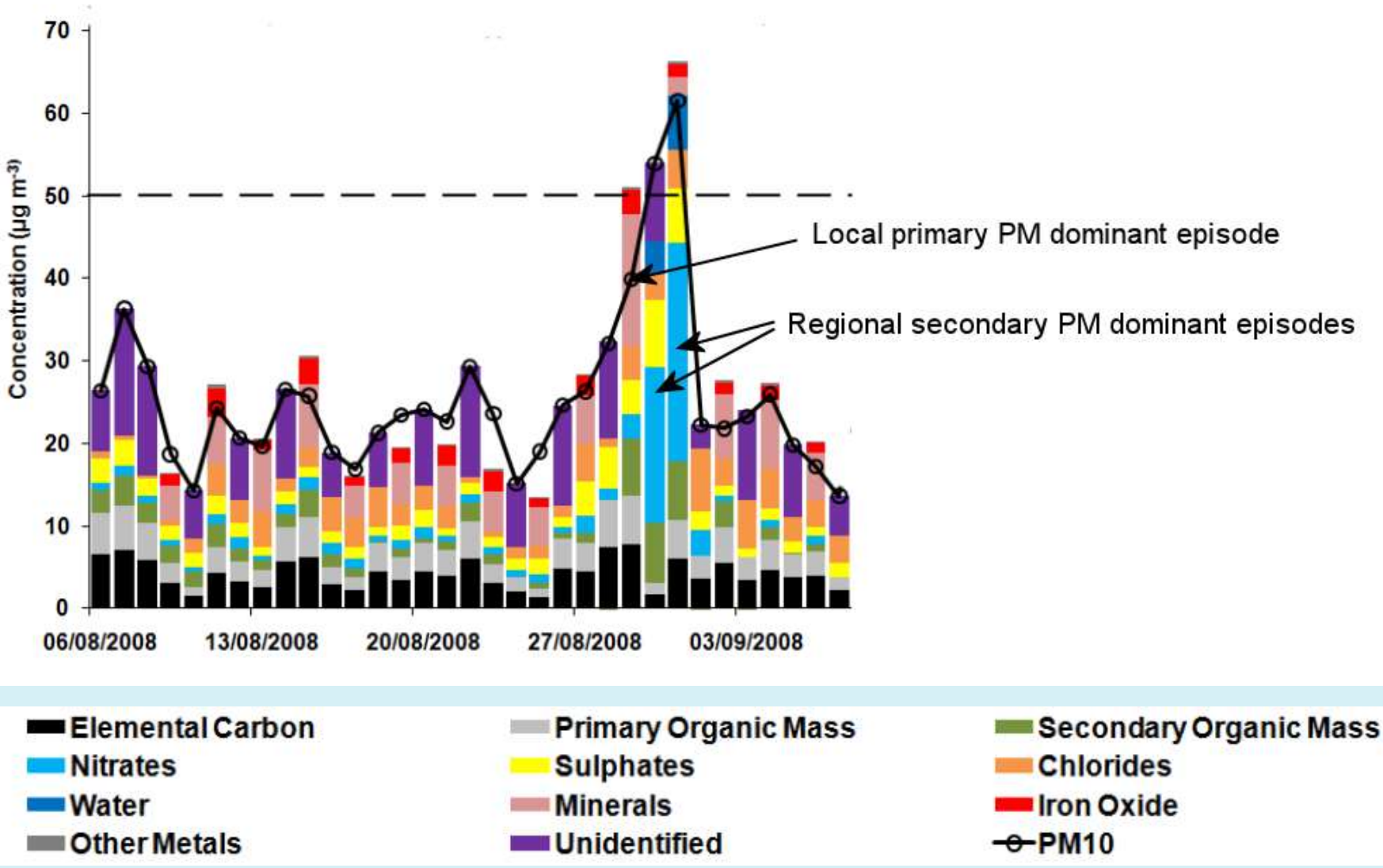


PM management by daily speciation

- ‘Hotspot’ PM sites chemically characterised and mass closure technique used to identify the cause of episodes.
- Specific components then targeted for reduction using local measures, e.g., resuspended mineral, elemental carbon.

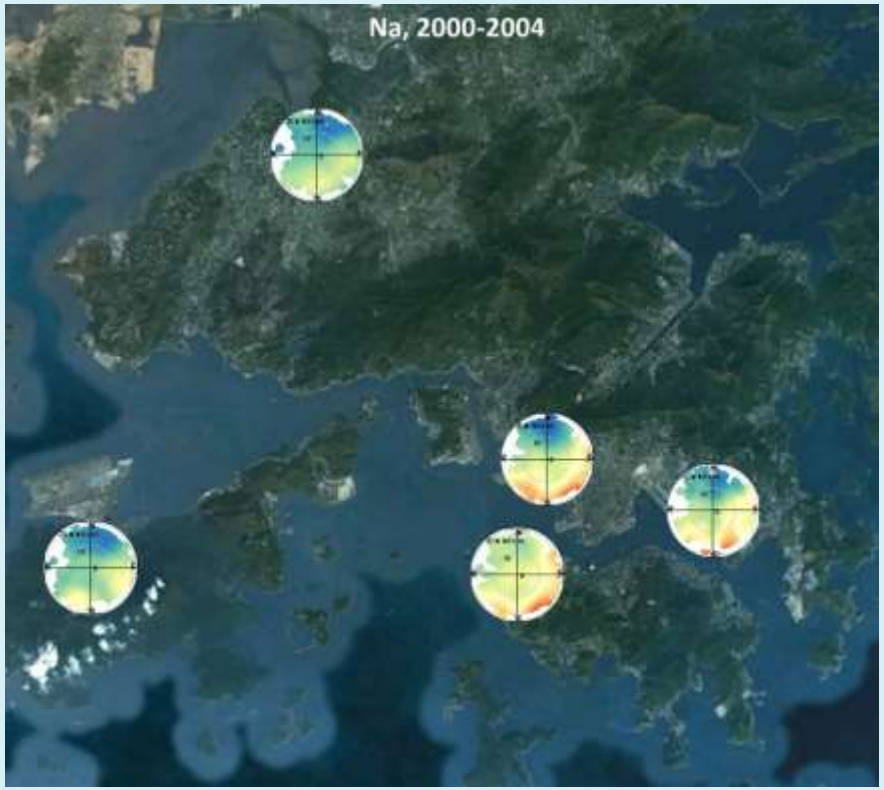


PM management by daily speciation



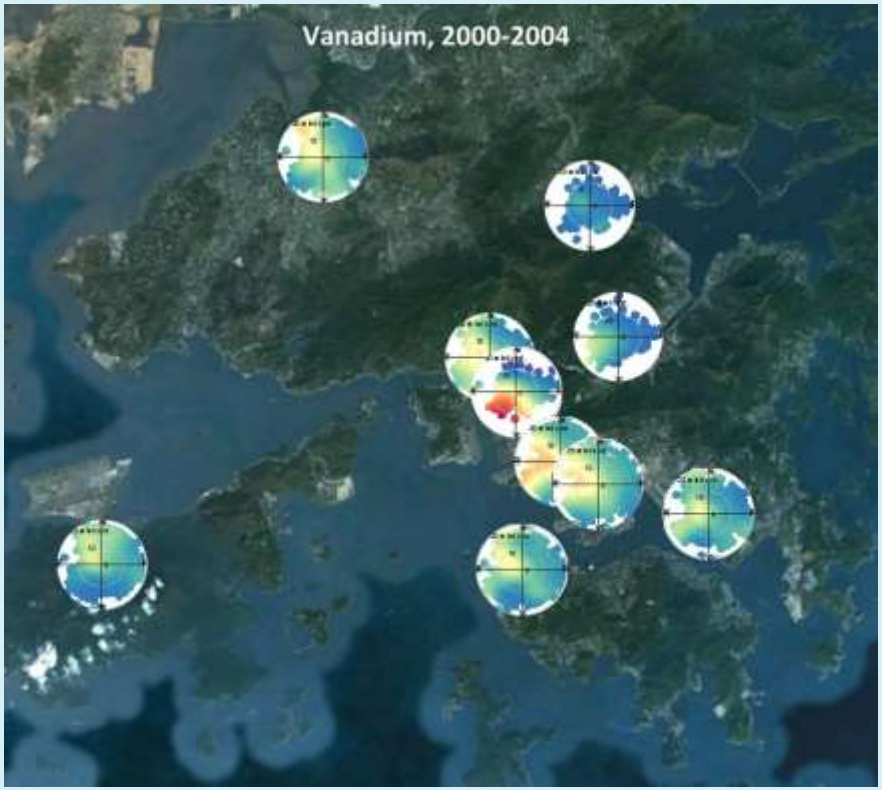
Episode characterisation – regional sources

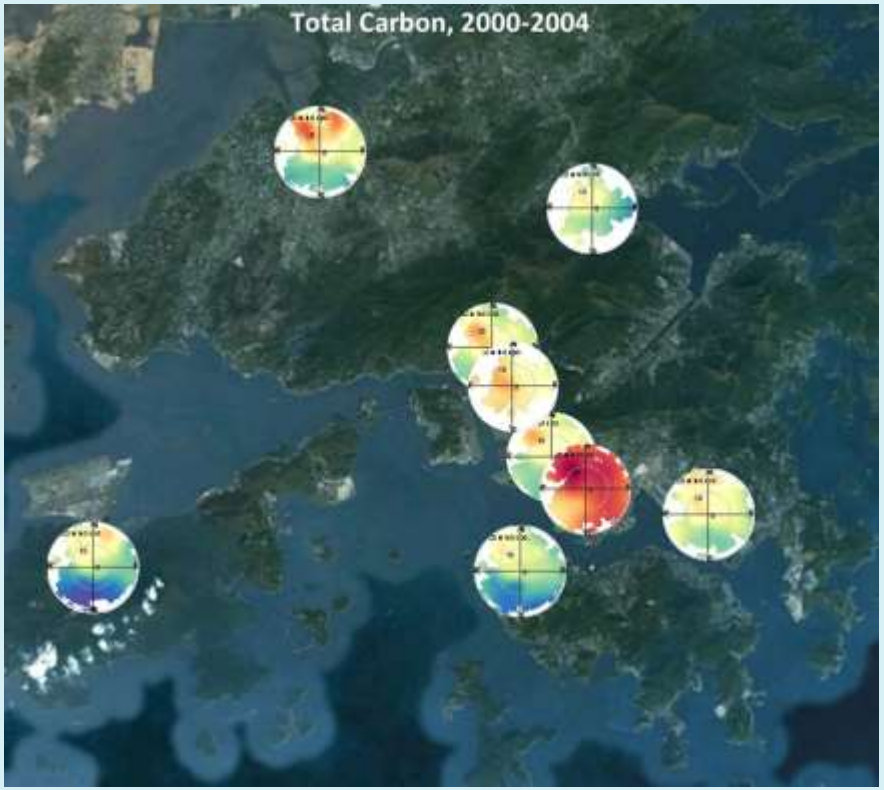
- Speciation analyses can also illustrate the sources of the dominant species during an episode.



Episode characterisation – local sources

- Characterisation will allow more effective control of $PM_{2.5}$.
- It will also provide greater accountability for actions.





Lessons learned from London

- Fuel controls have produced the swiftest beneficial impact.
- Improvements due to exhaust emission controls have stalled due to misleading emissions standards and increased diesel market share.
- Traffic controls – practically and politically possible, big is better, LEZs dependent on exhaust emissions standards (see above).
- Clean up solutions – prevention is better than cure; may have a very limited health benefit on an urban scale.
- Climate change actions are often, but not always win-win.

Emergency response for $PM_{2.5}$ episodes

- $PM_{2.5}$ is a complex pollutant with a mix of sources and behaviours.
- Reduction and emergency response cannot depend on single solutions.
- Detailed $PM_{2.5}$ measurements allow speciation and characterisation of episodes and sources.
- This will provide guidance, focus and evidence of progress in future.