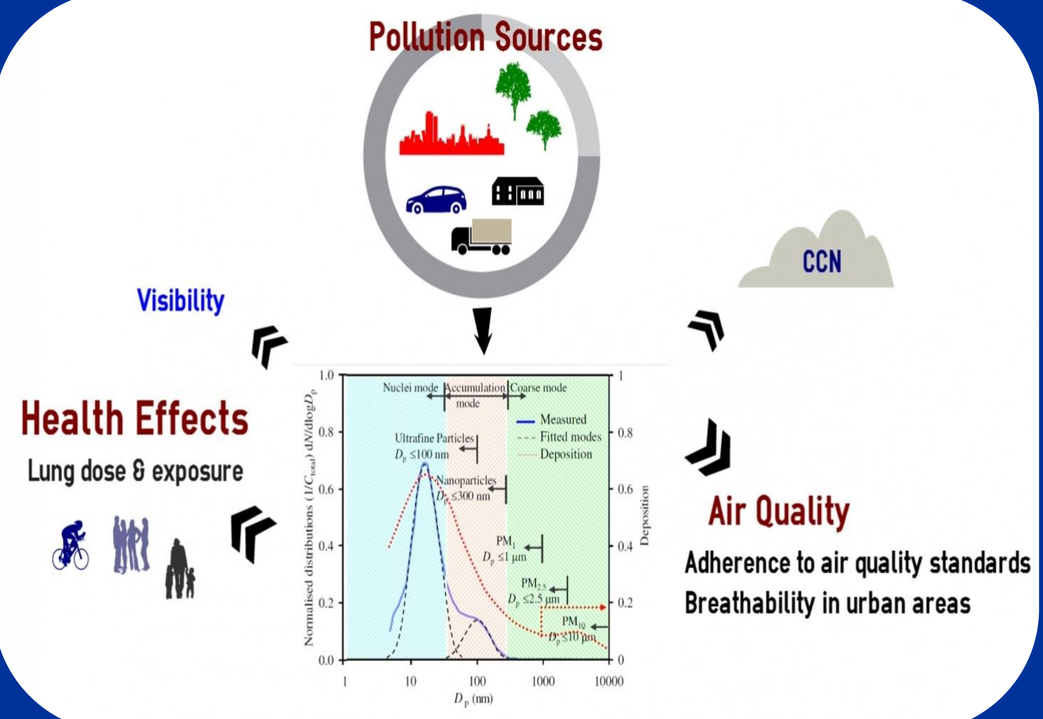
Chemical Characterization of Particulate Matter in New Delhi, India

Pallavi Pant[1], Stephen J.Baker[1], Sarath Guttikunda[2], Anubha Goel[3], Anuradha Shukla[4], Steven D. Kohl[2], Judith C. Chow[2], John G. Watson[2], Roy M. Harrison[1]*

[1]School of Geography, Earth and Environmental Sciences, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK
[2]DAS, Desert Research Institute, Reno, NV, USA
[3]Department of Civil Engineering, Indian Institute of Technology-Kanpur, UP, India
[4]Environmental Sciences Division, Central Road Research Institute, Mathura Road, New Delhi, India
**Now at Department of Environmental Sciences, University of Massachusetts, Amherst, MA, USA*
Contact: **pallavipant@schoolph.umass.edu**

Objective: To characterize PM composition and infer sources at an air pollution hotspot in New Delhi

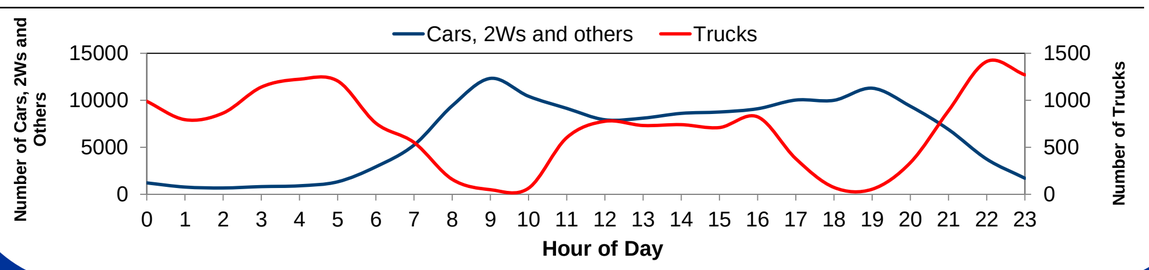


PM Samples

MiniVol
$PM_{2.5}$

MOUDI
Size-segregated PM

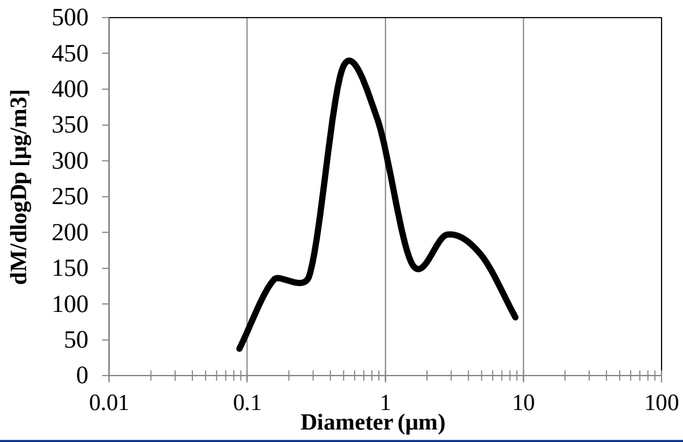
Site	Site characteristics	Sampling
Mathura Road/ National Highway 2	High traffic volume, stop-and-go traffic, mixed LDVs and HDVs *170,000 vehicles/day*	$PM_{2.5}$-June 2013 and *December 2013- January 2014* *Size-segregated PM- December 2013*



PM characteristics

12h concentrations higher than the NAAQS (60µg/m³) observed on several days in summer and all data in winter

Summer (mean ± sd) - **58.2 ± 35.0**
Winter (mean ± sd) – **276.9 ± 99.9**



Mass size distribution

PM- Trimodal with two peaks in accumulation mode (0.15 µm and 0.55 µm) and one peak in coarse mode (~3 µm)

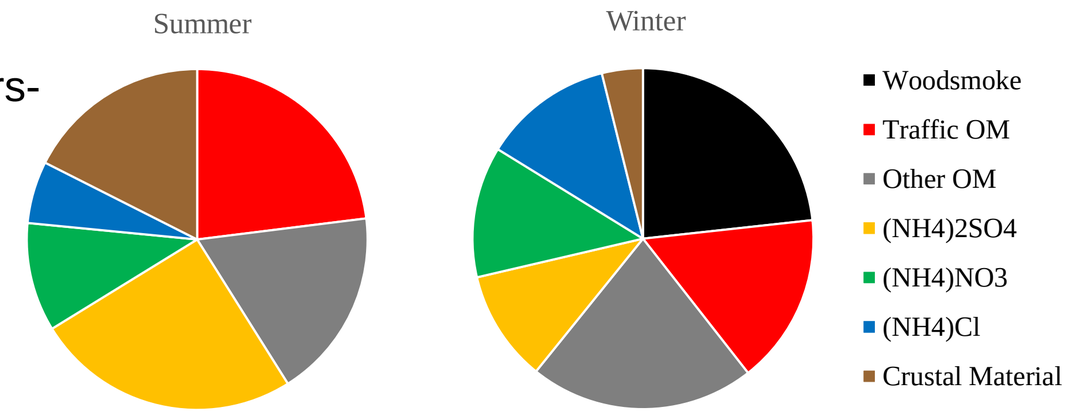
3/4th of PM mass in fine range

For elements, unimodal [Al, Cu]/ bimodal [S] and multimodal [Sb] distributions observed

Mass Closure

Sources inferred using following tracers-

- **Traffic-** Elemental Carbon
- **Biomass-** Levoglucosan
- **Crustal material-** Al, Si, Fe, Ca, Ti
- **Secondary inorganic aerosol-** Molar ratios
- **Other OM -** Organic Carbon



Key contributors

• **Organic matter (OM)** was the highest contributor in summer and winter

• Higher contribution from **sulphate, crustal material** in summer and **nitrate** in winter

•**Traffic** contributed 16% in winter and 23% in summer

Conclusions

• Concentrations in winter >> summer , especially for combustion-related species

• High contribution from biomass burning in winter, crustal dust in summer

• High enrichment for elements such as Pb, Zn, Cd, Ti, Sb, Cu

• Traffic/industry/crustal material- potential sources

• Size distributions are characteristic of winter season

• Droplet mode observed for several elements, and expected to be associated with hygroscopic growth

What's next

- Receptor modelling using Indian and other source profiles
- Characterization of source emissions

Acknowledgement

PP gratefully acknowledges financial support from the University of Birmingham. PP, RMH, JCC, SDK and JGW are thankful to UKIERI for partial support for the project. The authors would like to thank AMC facility at University of Birmingham for access to the XRF. SKG is partially supported by the PURGE project funded by the European Commission under the Grant Agreement No. 265325. The authors would also like to thank Mr. Rishu Kumar for assistance during the sampling.