Modelling and observations of secondary inorganic and organic aerosols in the UK & China

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Overview

CEH involvement in measurements & modelling of air pollution in China:

- Measurement evidence of the importance of cooking aerosol in London
- Importance of long-chain hydrocarbons from diesel vehicles for secondary organic aerosol formation & upscaling to UK
- Attribution of UK and urban PM to UK and non-UK precursors and assessment of relative potential of emission abatement
- Air Pollution and Human Health in a Developing Megacity (APHH-Beijing)
- Outlook & future work
BT Tower flux measurements - COA

Applying PMF to urban fluxes

Currently: Beijing APHH campaigns 2016/2017
First attempt at estimating COA at UK scale

**Figure 5.** Average hourly profiles of measured and modelled COA (averaged from approximately one year of measurements). The shading is the 95% confidence interval. The timestamp is at the beginning of the hour.

**Figure 4.** (a) Gridded COA emissions used in the model for the year 2012 (Mg per 5 km × 5 km grid cell), (b) annual average concentrations (μg m⁻³).

PM formation - OA from diesel emissions


Figure 17. Annually and seasonally averaged measured and modelled concentrations of SOA at the London North Kensington site.
In the analysis of current mitigation options, NH$_3$ and primary PM$_{2.5}$ emission control are equally effective, but for the 2030 scenario, primary PM$_{2.5}$ control yields higher reductions due to less SO$_2$ and NO$_x$ being available to form secondary inorganic aerosols with ammonia (*taking into account population-weighted concentrations*).


#UK Air Quality Expert Group
APHH-Beijing – Scientific Objectives (I)

- Determine the emission fluxes of key air pollutants and to measure the contributions of different sources, economic sectors and regional transport to air pollution in Beijing

- Assess whether the processes by which pollutants are transformed or removed through transport, chemical reactions and photolysis and the rates of formation and conversion of particulate matter via atmospheric reactions

- Quantify how the detailed properties of particulate matter evolve and can influence their physical properties and behaviour in the atmosphere and elucidate the mechanisms whereby those properties may interact and feedback on urban scale and regional meteorology

- To determine exposure of Beijing inhabitants to key health related pollutants using personal air pollution monitors and assess the associated between air pollution exposure and key cardiopulmonary measures
Determine the contribution of specific activities, environments and pollution sources to the personal exposure of the Beijing population to air pollutants derived from outdoor sources.

Carry out toxicogenomics and exposure genomics research, analyse genomics, epigenetics and metabolomics changes and examine screening biomarkers of exposure and effect.

Determine whether Beijing can achieve the APEC Blue’ by only reducing emissions from production sources and economic loss due to both physical and mental impacts of air pollution.

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APHH-Beijing – Projects funded

- **Theme 1:** Sources and emissions of air pollutants in Beijing (AIRPOLL-Beijing)

- **Theme 2:** An integrated study of air pollution processes in Beijing (AIRPRO)

- **Theme 3:** Air pollution impacts on cardiopulmonary disease in Beijing: An integrated study of exposure science, toxicogenomics and environmental epidemiology (APIC-ESTEE)

- **Theme 3:** Effects of air pollution on cardiopulmonary disease in urban and peri-urban residents in Beijing (AIRLESS)

- **Theme 4:** Integrated assessment of the emission-health-socioeconomics nexus and air pollution mitigation solutions and interventions in Beijing (INHANCE)
Outlook – Forecasting

EMEP4UK rv4.10 - EU and UK forecast (µg m⁻³) 20/11/2016 01:00

http://www.emep4uk.ceh.ac.uk/wrf_forecast
Outlook – Global to regional

EMEP4UK rv4.8 - GLOBAL, EU, and UK forecast (μg m⁻³) 01/01/2015 01:00