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

London Smog event in 2014 - http://www.thetimes.co.uk/tto/environment/article4053987.ece

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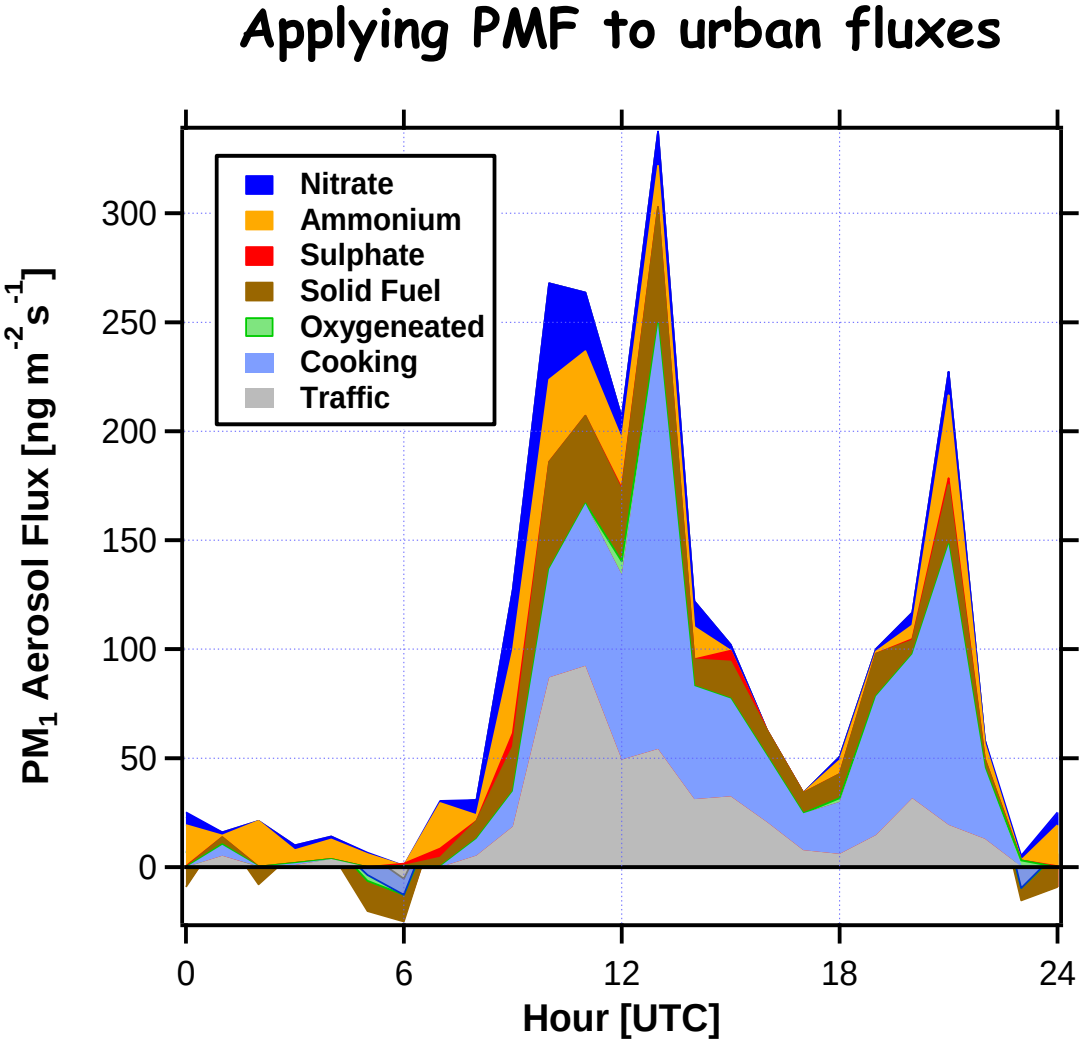
# Overview

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

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**Currently: Beijing APHH campaigns *2016/2017***

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# First attempt at estimating COA at UK scale

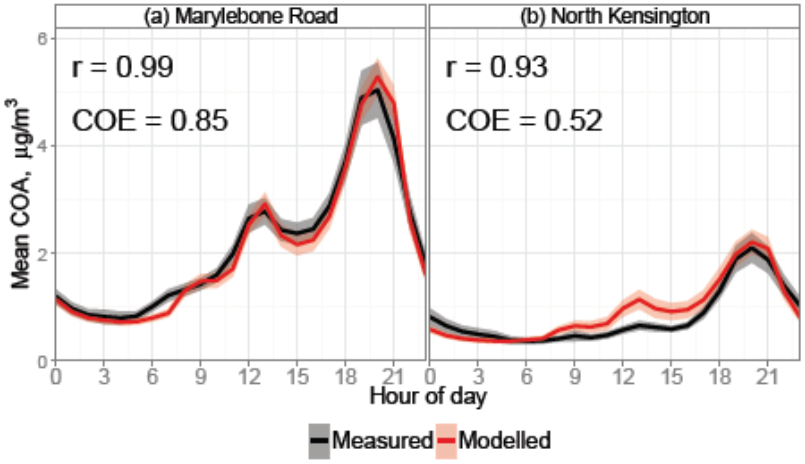


**Figure 5.** Average hourly profiles of measured and modelled COA (averaged from approximately one year of measurements). The shading is the 95% confidence interval. The timestamp is at the beginning of the hour.

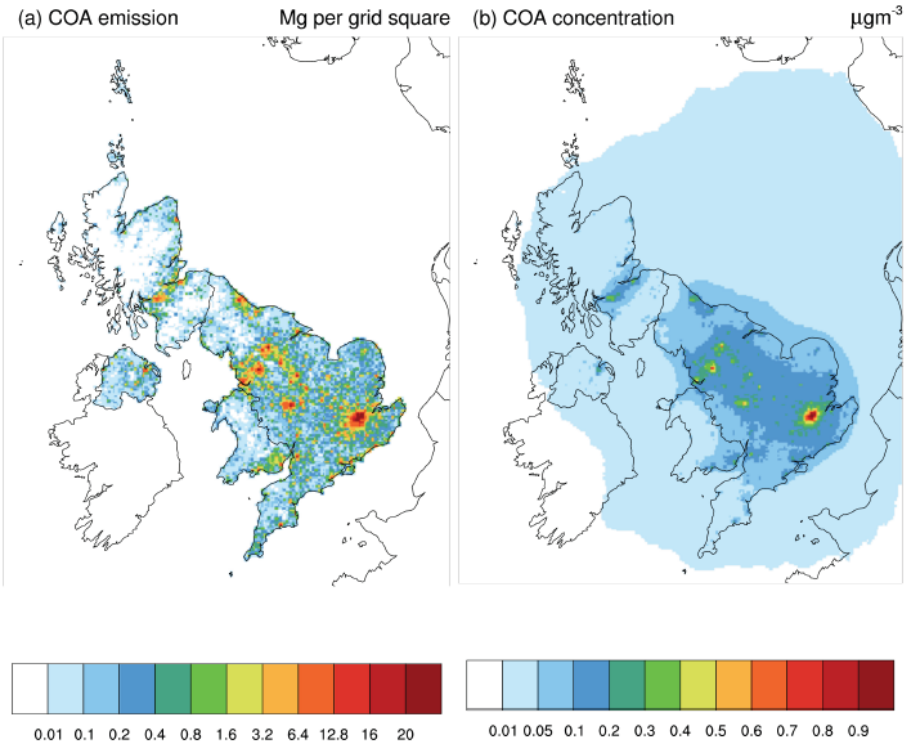


**Figure 4.** (a) Gridded COA emissions used in the model for the year 2012 (Mg per 5 km × 5 km grid cell), (b) annual average concentrations ($\mu g\ m^{-3}$).

*Ots R, Vieno M, Allan JD, Reis S, Nemitz E, Young DE, Coe H, Di Marco C, Detournay A, Mackenzie IA, Green DC, Heal MR (2016) Model simulations of cooking organic aerosol (COA) over the UK using estimates of emissions based on measurements at two sites in London. Atmos. Chem. Phys., 16, 13773-13789, 2016, http://www.atmos-chem-phys.net/16/13773/2016/*

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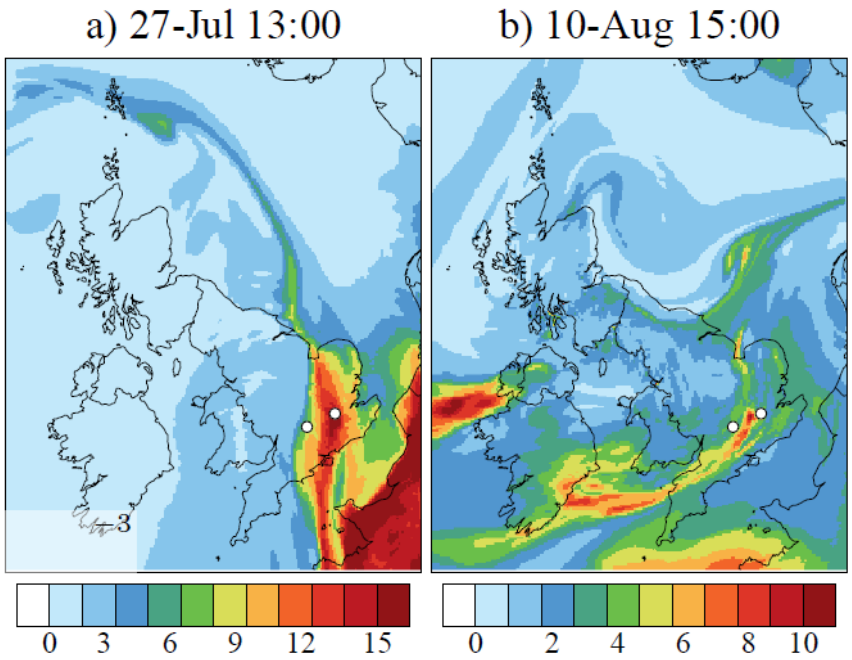
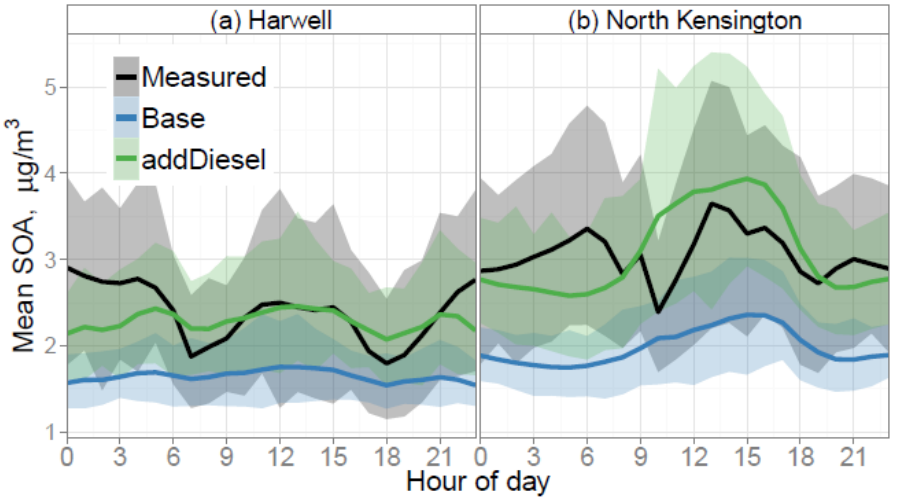
# PM formation - OA from diesel emissions



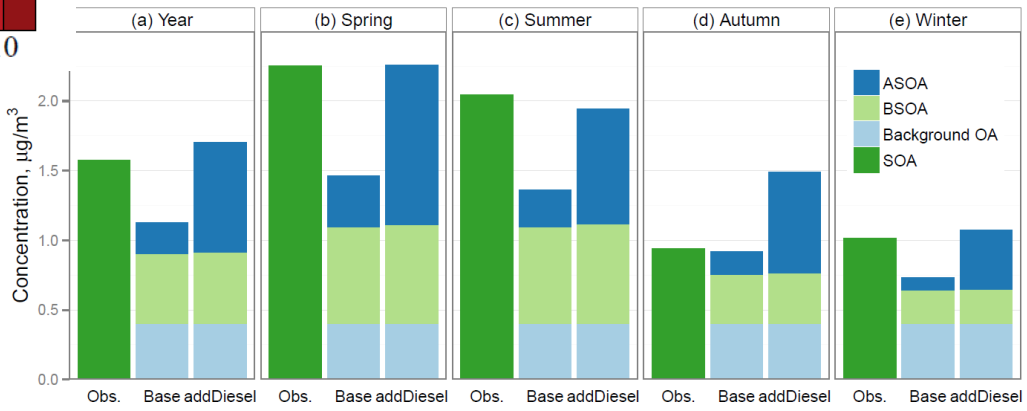




**Figure 17.** Annually and seasonally averaged measured and modelled concentrations of SOA at the London North Kensington site.

*Ots R, Young DE, Vieno M, Xu L, Dunmore RE, Allan JD, Coe H, Williams LR, Herndon SC, Ng NL, Hamilton JF, Bergström R, Di Marco C, Nemitz E, Mackenzie IA, Kuenen JJP, Green DC, Reis R, Heal MRH (2016) Simulating secondary organic aerosol from missing diesel-related intermediate-volatility organic compound emissions during the Clean Air for London (ClearfLo) campaign. Atmos. Chem. Phys., 16, 6453-6473. doi:10.5194/acp-16-6453-2016, http://www.atmos-chem-phys.net/16/6453/2016/*

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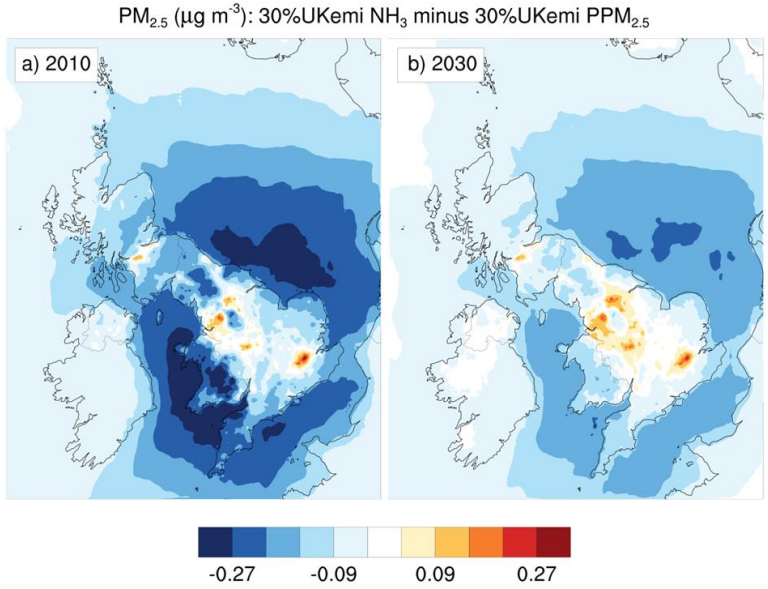
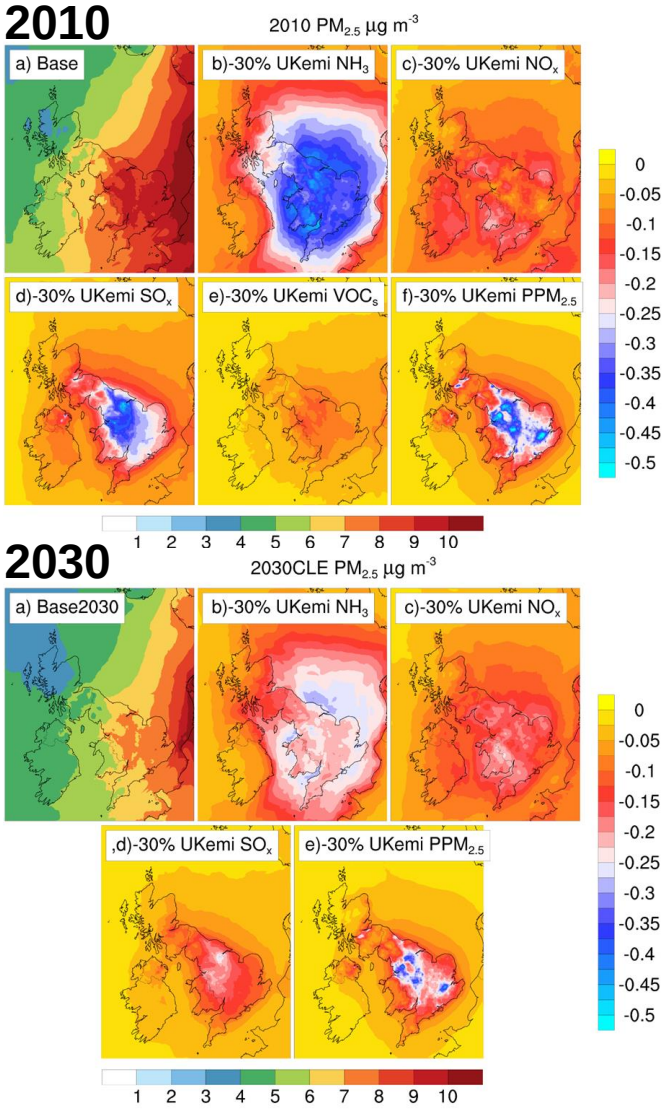
# EMEP4UK – $PM_{2.5}$ analysis for AQEG#

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)*




*Vieno, M., Heal, M. R., Williams, M. L., Carnell, E. J., Nemitz, E., Stedman, J. R., and Reis, S.: The sensitivities of emissions reductions for the mitigation of UK $PM_{2.5}$, Atmos. Chem. Phys., 16, 265-276, doi:10.5194/acp-16-265-2016, 2016*
http://www.atmos-chem-phys.net/16/265/2016/acp-16-265-2016.html

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# 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

# APHH-Beijing – Scientific Objectives (II)

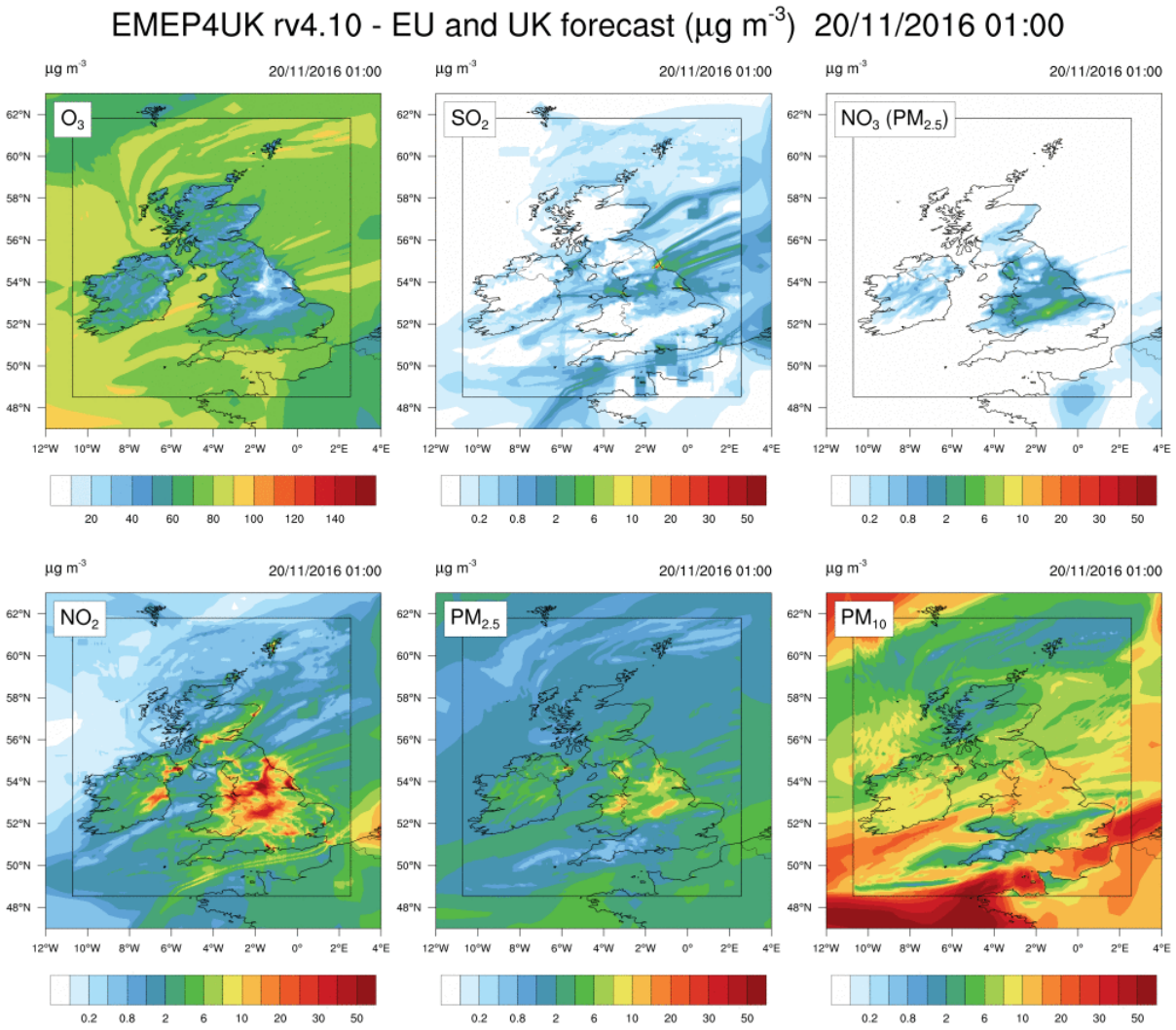
- Determine the contribution of specific activities, environments and pollution sources to the personal exposure of the Beijing population to air pollutants derived from outdoor sources
- Carry out toxicogenomics and exposure genomics research, analyse genomics, epigenetics and metabolomics changes and 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

*Five four-year research projects within the programme are funded by the Natural Environment Research Council (NERC), the Medical Research Council (MRC) and the National Natural Science Foundation of China (NSFC) – 2016-2020*

# 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

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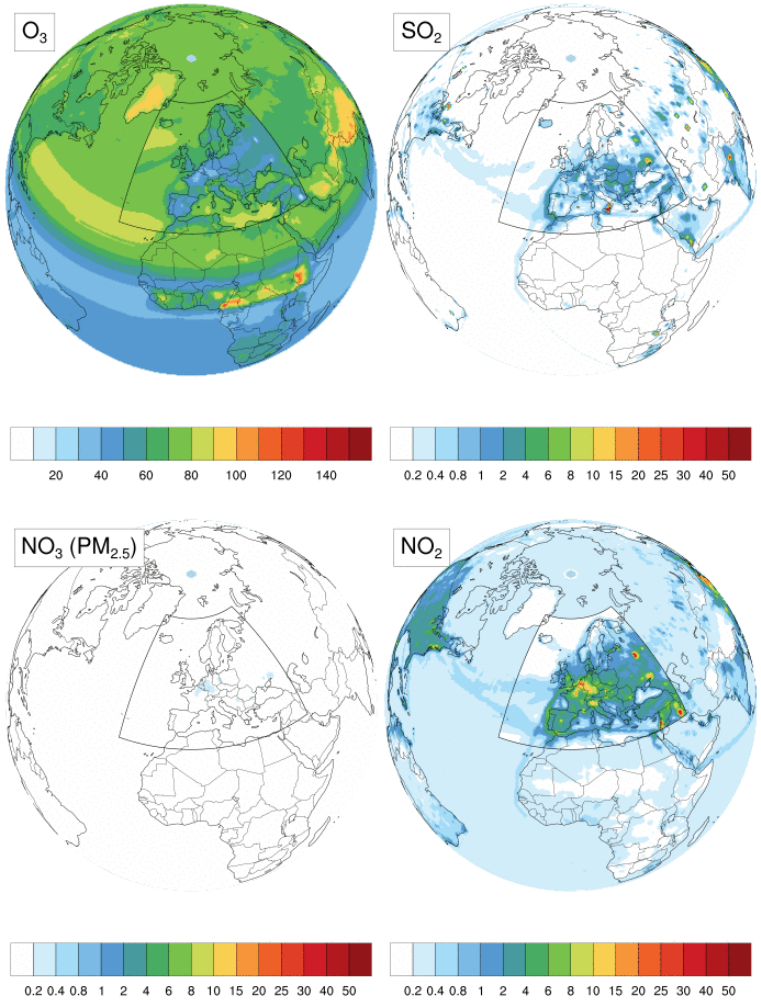
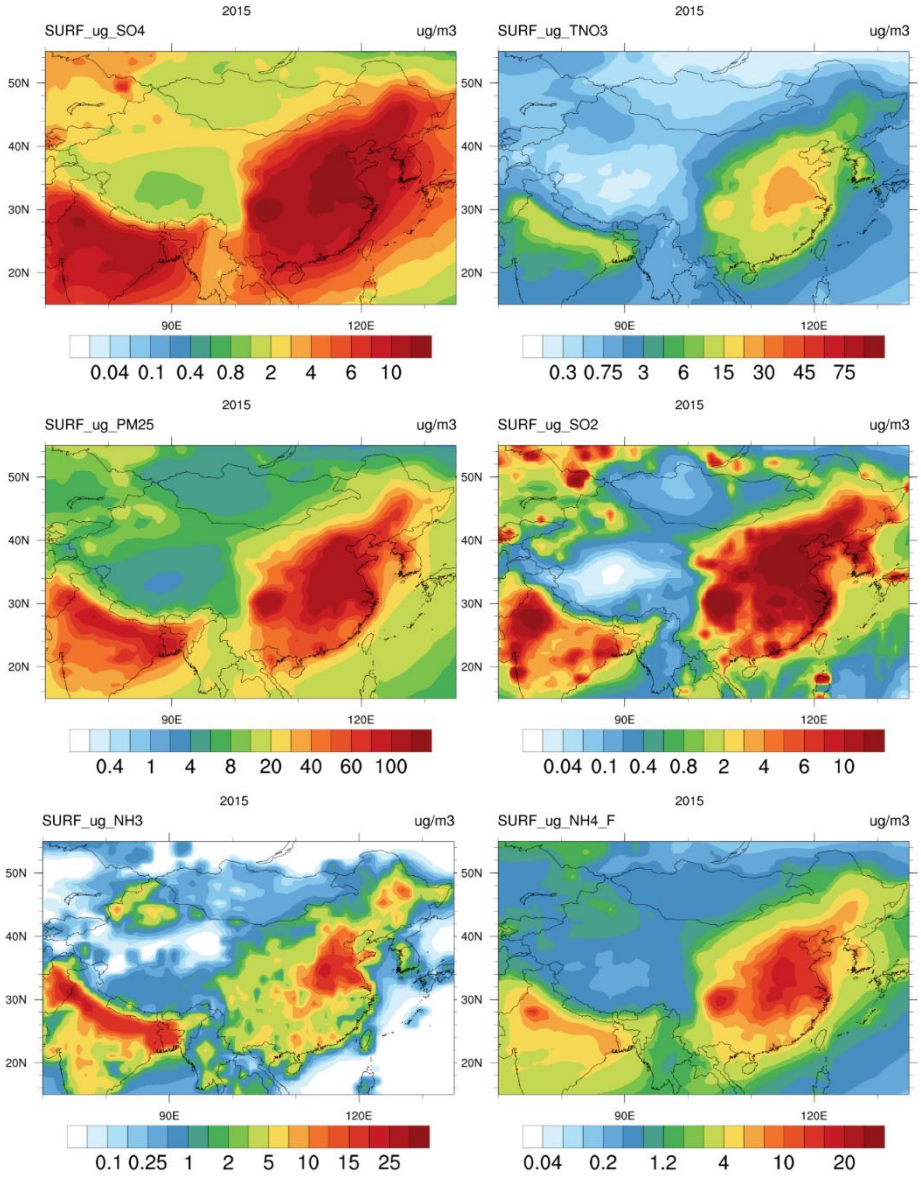
http://www.emep4uk.ceh.ac.uk/wrf_forecast

# Outlook – Global to regional

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

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