

How does the formation mechanism of atmospheric aerosol particles affect PM_{2.5} toxicity in Beijing ?

The overall aim of this PhD project is to elucidate the formation mechanism of aerosol particles in the atmosphere, and their consequent toxicity, in the context of a forthcoming major field campaign in Beijing.



Project Overview

Atmospheric particulate matter (PM) is produced from a range of direct emission sources (primary particles), and through within-atmosphere chemical processes (secondary particles - particularly important for smaller particles such as PM_{2.5}, those less than 2.5 μ m in diameter, which pose the greatest human health risks). Secondary aerosol particles account for over 70 % of the PM_{2.5} budget in Beijing during pollution episodes (Huang et al., Nature 2014; Guo et al., PNAS 2014) and many other cities worldwide, and are formed through a range of mechanisms - however it is uncertain which mechanisms dominate in haze events, and how the toxicity of the resulting PM varies. Within this project, we will use a combination of planned and new observations to assess the dominant mechanisms for secondary PM formation during haze events in Beijing; replicate the observed PM formation from individual processes under the controlled conditions of a large atmospheric simulation chamber, and assess the toxicity of the PM_{2.5} particles formed through contrasting mechanisms.

This project links to a forthcoming field measurement project in China, through which Birmingham will lead a consortium of UK Universities, working in partnership with leading institutions in China (Tsinghua University, Peking University, Chinese Academy of Sciences) to study the sources of air pollutants in Beijing. The doctoral researcher will join the wider project team at Birmingham and will collaborate with researchers from across the consortium.

This specific PhD project will comprise

- Collection of atmospheric PM samples during the forthcoming field campaigns in Beijing (2016, 2017) from ambient air, and from a panel study cohort.
- Analysis of PM formation mechanisms using online measurements of aerosol properties (already planned within the main programme), and new analyses of the PM samples using a novel NanoSIMS approach to assess the mixing state of individual particles during haze events. This will provide new insight into the relative importance of different PM formation mechanisms.
- Replication of the formation of aerosol particles in a new environmental (smog) chamber, using realistic (Beijing) atmospheric conditions, manipulated to favour alternative PM formation mechanisms.
- Assessment the health impact of both the ambient PM samples and those derived from individual processes in the chamber experiments, via measurement of their oxidative potential through laboratory test assays (DTT and plasmid assays, looking at ROS activity and DNA damage potential respectively).

Research Environment & Supervision

The student will join the Environmental Health Sciences (EHS) research group at the University of Birmingham. They will be supervised by Dr William Bloss and Dr Zongbo Shi, and will also be expected to interact with other interested staff in the group, notably Prof Roy Harrison, who is lead PI for the "Sources" theme project, AIRPOLL-Beijing, within the overall NERC programme. The

doctoral researcher will work alongside other PhD students and postdoctoral researchers working on the Beijing project, and other closely related atmospheric science research.

Bloss is a Reader in Atmospheric Sciences and Deputy Head of the School of Geography, Earth & Environmental Sciences. He has extensive experience in atmospheric field observations, laboratory studies and chamber studies. Shi is an expert in aerosol formation, composition, and atmospheric processing, including measurement of oxidative potential via the DTT and Plasmid assays. Both Bloss and Shi lead active research groups, comprising 5 PhDs and 2 PDRAs (Bloss), and 6 PhDs (Shi). Both are Co-Is for projects within the NERC Air Pollution and Human Health - Beijing programme.

More broadly, the EHS group comprises 10 academic staff leading research teams in Air Pollution / Atmospheric Chemistry / Meteorology and Climate, comprising some 45 postdoctoral research staff and PhD students in total; the student will therefore join a vibrant research environment with critical mass, internal and external seminar series etc. and the breadth of expertise for new outcomes from the work to be appreciated and explored.

For further information please see the following websites:

<http://www.birmingham.ac.uk/research/activity/environmental-health/index.aspx>
<http://www.atmos.bham.ac.uk/>

Training and Support

All PhD students at Birmingham are assigned two supervisors (here, Dr William Bloss and Dr Zongbo Shi), and an independent academic mentor. Students follow an initial induction course, in the course of which a formal skills assessment is completed and individual Personal Development Plan developed. Progress through the PhD and training programme is monitored through minuted monthly supervisory meetings and formal six-monthly progress review boards involving external staff, in addition to day-to-day contact with the PIs. In addition, the student will receive ongoing informal support from the PI's research groups, and in particular the PDRAs who will be working on the Beijing measurement project.

The Personal Development Plan will comprise (1) personal skills training - targeted at all aspects of the Vitae Researcher Development Framework; (2) scientific knowledge and (3) core project skills.

-Personal skills training will be achieved through School and University training; Birmingham is lead institution for the CENTA DTP, and we will draw upon the CENTA training for personal skills development and generic academic / analytical training.

-Scientific knowledge development will be supported (dependent upon background) through attendance at modules on the MSc Air Pollution Management & Control / MSc Applied Meteorology & Climatology courses at Birmingham, to provide a thorough understanding of atmospheric science and the theoretical basis for the air pollution and human health objectives of the project, alongside NCAS training (e.g. Summer School on Atmospheric Measurement) at an appropriate stage in the PhD.

-Core project technical / analytical skills will be provided through the PI's research groups, which include current PhD students and PDRAs working on related topics and staff with complementary expertise at Birmingham, in addition to the APHH-specific research staff (see Academic Research Environment, below).

-In addition to participating in the field campaigns in Beijing, the student will be encouraged to present their work at UK and international conferences, for example AGU (San Francisco) or EGU (Vienna).

Project Partners and Collaborators

Dr William Bloss and Dr Zongbo Shi will be lead supervisors for this project. Additional input, within the Beijing measurement programme, will be provided by :

-Prof. Tong Zhu, Peking University, School of Environmental Science and Engineering. Zhu is Head of the School of Environmental Science and Engineering, and is the Chinese lead PI of the “Health Effects” Theme project; he will provide personal exposure PM samples for the Beijing cohort to supplement the ambient sample collection.

-Prof. Hong Li, Chinese Research Academy of Environmental Sciences (CRAES), Beijing: Li is the lead scientist for the smog chamber at CRAES, which will be used to carry out targeted experiments to simulate atmospheric aerosol formation. We will then collect the samples for oxidative potential and chemical analysis to test the hypothesis that atmospheric aging enhances toxicity (note that the chamber work for the PhD does not require analysis of chamber datasets - simply use of the facility to produce PM samples for analysis).

-Prof. Kebin He, School of Environment, Tsinghua University, Beijing and Prof. Pingqing Fu, Institute of Atmospheric Physics, Chinese Academy of Sciences will provide online aerosol data, which will be combined with the new NanoSIMS analyses to understand the relative importance of different formation mechanisms of the secondary aerosols.



Further Information and How To Apply

This project is fully funded (fees, living costs, research costs) through the NERC Air Pollution and Human Health in a Developing Megacity (Beijing) and NCAS Atmospheric Science studentships schemes.

Interested applicants are encouraged to email Dr Bloss (w.j.bloss@bham.ac.uk) or Dr Shi (z.shi@bham.ac.uk) as soon as possible for informal discussion.

Applications will be reviewed on an ongoing basis until the studentship is filled, with a deadline for applications of 31 March 2016. The studentship will start in Autumn 2016.

Online Application Procedure

NB Email your CV to Dr Bloss or Dr Shi directly also !

Complete the online application form for the University of Birmingham - Use the link : <https://sits.bham.ac.uk/pages/LES030.htm>

And choose the option for “PhD in the Department of Environmental Health and Risk Management” – Full Time Research – 2016/17 – the option one up from the bottom (see pic below). Your PhD will be in the School of Geography, Earth & Environmental Sciences, and the PhD title will be based upon the specific project – ignore the labelling on this web page.

Programmes open for Admission			
Programme	Mode of Attendance	Year	Apply
MPhil (Research) in Department of Environmental Health and Risk Management	Full-time Research	2015/16	Apply Now
MPhil (Research) in Department of Environmental Health and Risk Management	Part-time Research	2015/16	Apply Now
MPhil (Research) in Department of Environmental Health and Risk Management	Full-time Research	2016/17	Apply Now
MPhil (Research) in Department of Environmental Health and Risk Management	Part-time Research	2016/17	Apply Now
PhD in Department of Environmental Health and Risk Management	Full-time Research	2015/16	Apply Now
PhD in Department of Environmental Health and Risk Management	Part-time Research	2015/16	Apply Now
PhD in Department of Environmental Health and Risk Management	Full-time Research	2016/17	Apply Now
PhD in Department of Environmental Health and Risk Management	Part-time Research	2016/17	Apply Now

Please complete the online application form, and ensure that you mention the specific project title, and our names as supervisors (Dr William Bloss, Dr Z Shi) in the Research Information section.

When you have submitted your application, you will receive a University Applicant ID Number. Please email this directly to us (w.j.bloss@bham.ac.uk) to ensure the application finds its way to us quickly.

The other thing you can do to help is to ensure your referees reply quickly to the reference request and complete the reference form online.

Thanks – and our apologies for this non-user-friendly system...