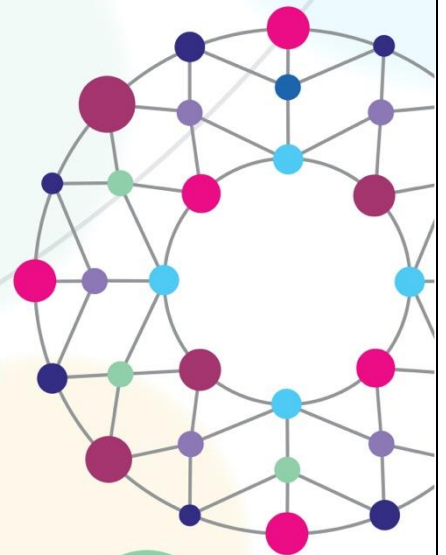
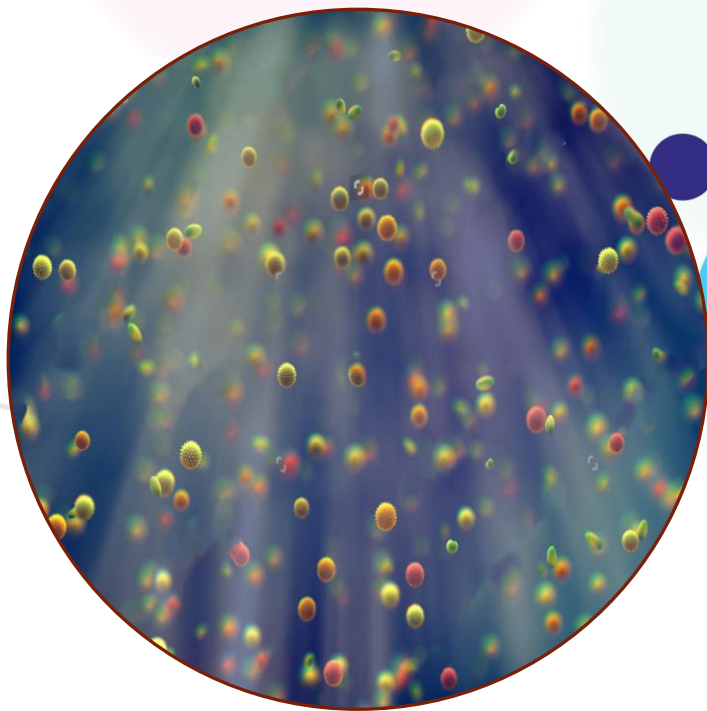


BioAirNet.

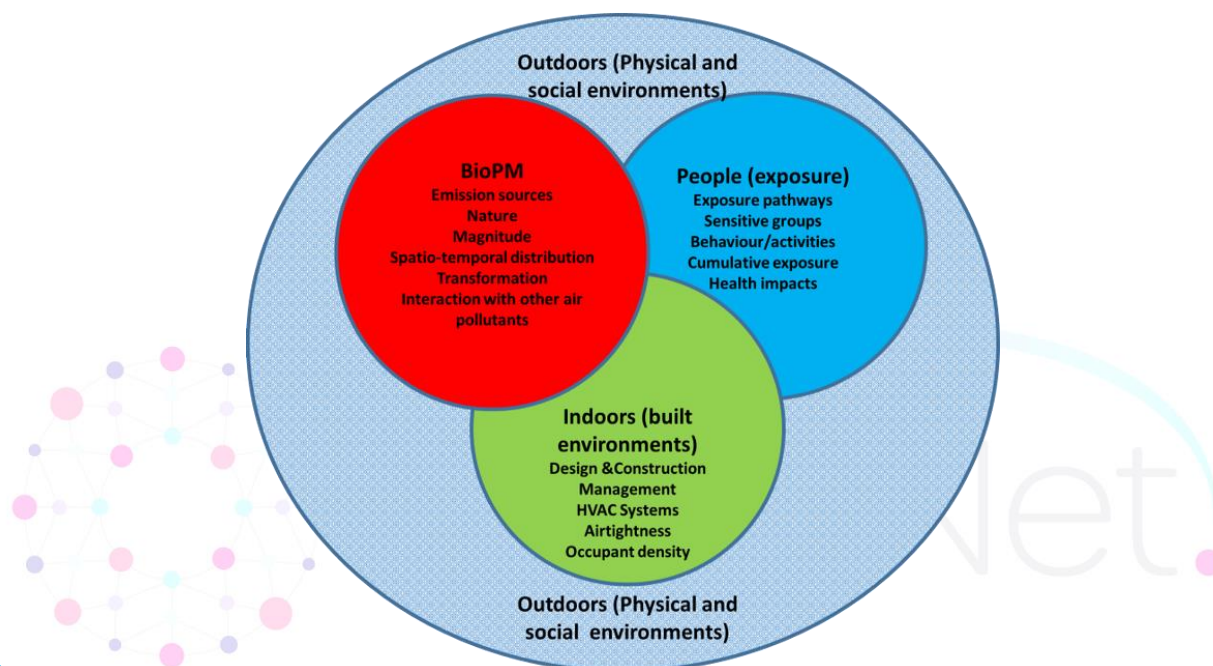


## BioAirNet Newsletter

May 2021

Welcome to the first BioAirNet newsletter, offering a roundup of network activities and future events.

**BioAirNet addresses the interdisciplinary challenge of characterising the emission dynamics, exposure profiles and health impacts to particulate matter of biological origin (BioPM) across a continuum of different indoor and outdoor environments.**



This issue provides an update on the recent BioAirNet activities, including BioAirnet launch event and the thematic workshops.

## BioAirNet Launch Event

The online inaugural event was held on 11 December 2020. The focus was to provide an overview of BioAirNet themes and activities along with presentations from a range of stakeholders from academia, industry and regulators on topics covering air quality and BioPM health impacts, interventions and the regulatory landscape. Interactive discussion between participants was used to shape future events.

The event was attended by 105 international participants, representing industry, academia, regulatory organisations, and not-for-profit and charitable organisations, including investigators



from other Strategic Priorities Fund Clean Air Programme funded networks. The event was organised in three sessions comprising

- i) BioAirNet network overview;
- ii) Existing work and Stakeholder perspectives;
- iii) Getting involved with BioAirNet and next steps.

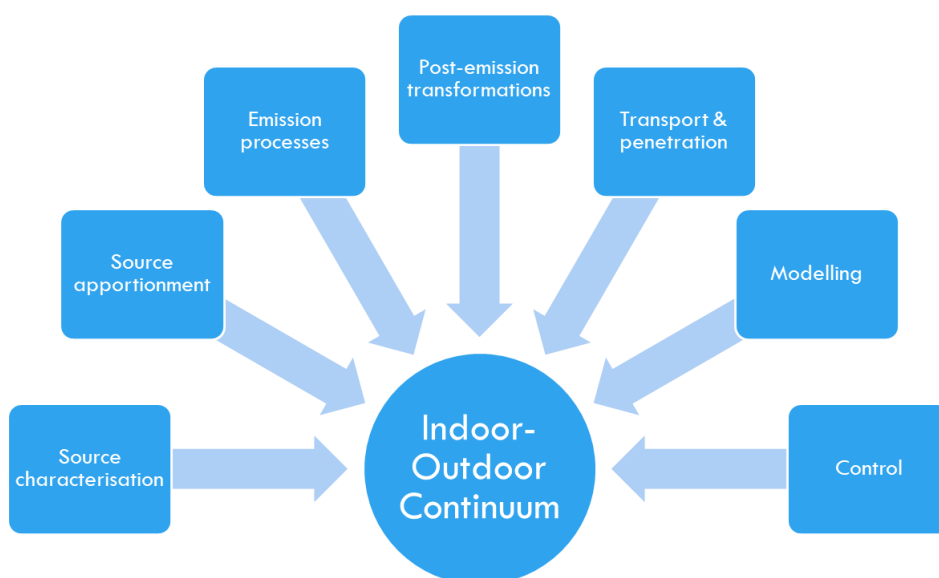
Presentation slides are available on the BioAirNet website: <https://bioairnet.co.uk/bioairnet-launch-event/>. During the interactive session on next steps for BioAirNet, the participants highlighted the following areas for future BioAirNet events;

- Understanding the socio-economic impacts of avoiding and adapting to BioPM
- Rapid detection and characterisation of BioPM (focusing on molecular and real time detection methods)

BioAirNet includes four interdisciplinary themes: 1) BioPM sources and dynamics at the indoor/outdoor environments; 2) BioPM sampling and characterisation; 3) Human health, behaviour and wellbeing; and 4) Policy and public engagement. Each theme organised a specialised event, which took place in February and March 2021. A brief overview of each workshop is below.

## Theme 1 Workshop: Biological particulate matter sources and dynamics

The workshop aimed to introduce the proposed thematic scope and outputs, engaging the view of the participants on which topics the network would like to focus in future events and who are the key stakeholders.



**Potential scope of biological particulate matter sources and dynamics theme.**



The event was held on 22 February 2021 and attended by over 25 participants. During the interactive online session, there were presentations from the theme leads and an invited speaker. These are available at <https://bioairnet.co.uk/theme-1-biological-particulate-matter-sources-and-dynamics-22-february-2021/>. The discussion with participants from academia, industry practitioners and regulators centred on two questions:

**Discussion question 1:** What should we focus on in future network meetings?

**Discussion question 2:** Who are the stakeholders we should be engaging and inviting to future meetings?

## Recommendations

### *Discussion question 1:*

- What sort of emerging and existing air cleaning devices and technologies are suitable for different indoor-outdoor scenarios? The SAGE-EM review of air cleaning devices [<https://www.gov.uk/government/publications/emg-potential-application-of-air-cleaning-devices-and-personal-decontamination-to-manage-transmission-of-covid-19-4-november-2020>] and possible follow-up research is of great interest here.
- What is the impact of the interaction of BioPM with other chemical pollutants?
- Comparison of indoor/outdoor microbial diversity (including seasonality).
- How do different indoor – outdoor factors affect sampling strategies?
- Up to what extent, and how, can we compare different studies in varying scenarios?
- Is there a framework/protocol for contemporaneous indoor and outdoor measurements of source-specific exposure - disentangling anthropogenic and naturally occurring BioPM to study specific health conditions?
- Development of guidelines and protocols for selecting and comparing studies from different indoor-outdoor environments.
- There's a real gap in knowledge around particle size / aggregation / rafting and particle penetration into buildings.
- What is the link between the BioPM exposure, including the microbiome, and the impacts on our health?
- Is indoor pollen measurement a topic of interest for research?
- Understanding of indoor-outdoor co-exposure and the accumulative effect that this can have on health outcomes.
- Exploring the link between energy efficient buildings (airtight, reduced air exchange rate) and potential risks of exposure to indoor BioPM.
- Fate, behaviour and transformation of BioPM (focusing on evaporation, condensation, open-air factors).
- Modelling the emission, distribution and deposition in indoor as well as outdoor.
- Measurements of resuspension and deposition (indoors and outdoors).



- How to integrate human behaviour and human space interactions in modelling studies?
- Validation of dispersion modelling especially for process-based BioPM emission.
- SARS-CoV-2 is driving a huge amount of research relevant to Theme 1 – we should look for the opportunities to identify and discuss new knowledge emerging from this.

### *Discussion question 2:*

- Continue the existing approach of engaging with diverse stakeholders.
- Need to focus on emerging and overlapping topics across different BioAirNet themes. The overlap of interests around sources, post-emission dynamics, measurement and exposures is emerging as the priority.
- Arrange joint sessions with other Clean Air networks such as Breathing City: Future Urban Ventilation Network on areas of mutual interest.
- Suggestions were made for contacts we should approach to participate in future thematic sessions nationally and internationally, including representatives of complementary networks.

## **Theme 2 Workshop: Biological particulate matter sampling and characterisation**

This workshop was held on 3 February 2021 and over 50 participants attended it. The focus was exploring the knowledge gaps along with barriers and opportunities for sampling, detection and characterisation of BioPM in different indoor-outdoor scenarios, and identifying and providing recommendations for priority research areas. The presentations can be accessed at <https://bioairnet.co.uk/first-thematic-bioairnet-workshop/>.

The sessions comprised of invited presentations from academia and regulators, followed by interactive discussion sessions with participants in smaller breakout rooms on the following two questions:

**Discussion question 1:** What do we need for sampling and analysis methodology harmonisation?

**Discussion question 2:** What is the role of emerging technologies to investigate indoor/outdoor atmospheric microbiome and support regulatory needs?

## **Recommendations**

### *Discussion question 1:*

- A critical need to identify health outcome-based endpoints supported by data validation.
- Enabling a variety of sampling and detection methods to meet the requirements of “End Point” – target analytes.



- Developing a framework which can be used to evaluate the utility and suitability of different sampling and analysis methods to that endpoint.
- Existing endpoints are supported by data from conventional methods.
- Need for identifying the key target health outcome endpoints, exploiting the data from emerging detection technologies.
- Improving the baseline data utilising emerging molecular methods.
- Development of guidelines for exposure limits that can be used to inform sampling and analysis methodology harmonisation.
- Compendium of measuring systems (pros/cons e.g. portability, cost, efficiency etc) e.g. fluorescence lifetime for BioPM.
- Need specific protocol from 'lab to field', which depends on the industry and so needs to be industry specific.
- Need to know complete composition of BioPM (including relative abundances) and which fractions cause human health problems.
- Need a suite of target organisms for each industry/environment.
- Need to know size fractions, particularly in occupational exposure for inhalable fractions that cause health effects.
- Need for comparison of methods (Stationary, active, passive, personal sampling, Maldi-TOF with culture vs DNA sequencing).
- Development of decision support tools for choosing the appropriate sampling and analysis methods for a range of environments and measurements objects, along with sampling design strategies.
- How evolving sampling and analysis approaches relate to regulatory needs – what is required?
- For UV-LIF based detection systems there is need for developing standard reference materials for fluorescence measurements and intercomparison of UV-LIF based measurements.
- Need to improve certainty in the assignment of the fluorescence to potential biofluorophores and data analytic approaches for discrimination of BioPM.

### *Discussion question 2:*

- Real-time UV-LIF based measurement has a potential to advance understanding of the BioPM (temporal profile, size distribution, composition).
- Opportunity for new methods e.g. DNA sequencing to identify a much greater range of microbes.
- Emerging detection technologies can provide a wealth of information on the microbiome – the question is so what?
- How do the emerging detection methods compare with existing methods applied in the regulatory domain?
- These can advance understanding of the nature and determinants of microbiomes in complex indoor-outdoor interface systems.
- Standardisation and validation are required.



- There is a need to link the environmental exposure of concern (above a certain background exposure) to the exposome.
- Translation of this new knowledge to inform regulatory needs require a strong interdisciplinary alignment with the toxicology field.
- Useful in improving our knowledge on risk of exposure and risk of development of disease through understanding the properties of BioPM and potential mechanisms of toxicity.
- Improving numerical modelling capabilities to predict airborne behaviour and resultant health outcomes.
- There is room for different methods and technologies addressing a specific need, but there is also a need to maintain comparability within, and between, different methods.
- Developing a decision tree framework for a group of technologies for different indoor-outdoor scenarios.
- Opportunities to work closely with industry and regulators to improve risk assessment and management strategies.

## Theme 3 Workshop – Human health, behaviour and wellbeing

This workshop was held on 25 February 2021 and 60 participants attended it. The event was primarily focused on sharing the aims and scope of the theme and i) exploring the knowledge gaps along with barriers and opportunities for identifying the associations and underlying biological mechanisms between BioPM exposures and health outcomes in different indoor-outdoor scenarios; ii) identifying and providing recommendations for priority research areas.

The session included presentations from lead researchers exploring the associations between BioPM and respiratory and neurological disorders and the approaches that can be used to understand the biological mechanisms underlying these associations (available at: <https://bioairnet.co.uk/bioairnet-theme-3-workshop/>), followed by interactive discussions with participants on the following two questions:

**Discussion question 1:** What are the knowledge gaps and methodologies required to quantify levels of exposure to indoor/outdoor BioPM and links with health impacts in different scenarios?

**Discussion question 2:** What are the methodologies and approaches needed to understand the mechanisms of harm to human health and wellbeing?

## Recommendations

### *Discussion question 1:*

- Lots of phenotypic data but difficulty in getting good population exposure data. Dream data set – long term exposure data for as many pollutants as possible with matching health and



social data from the same period and longer (and confounder information – income/access to healthcare).

- How to model exposure and how to get sufficient statistical power?
- Need to focus on specific/vulnerable populations.
- What exposure data do we need to focus on – population vs personal?
- How to ensure the homogeneity of data?
- What is the potential of new technologies (e.g. real-time BioPM measurement) to inform exposure?
- Identify proxy methods – cheaper, may not be in detail but may provide enough information?
- What is best as a proxy/biomarker of exposure?
- Development of biosensors?
- What is the relationship between changes in exposure and emission scenarios and their impact on vulnerable populations?
- A lot of data on pollen and a bit on spores but most of these data are old so the level for modelling may not appropriate.
- Need to consider seasonality and age groups.
- Important to differentiate between exposure triggering inflammatory response vs allergy response (pollen/spores vs pathogens/airborne) - seems to be two focused research groups.
- Need for understanding the background exposure to quantify the health risks of exposure to BioPM.
- Can we design personal devices for monitoring/quantifying exposure?
- How to best link exposure to health outcome?
- How to use different exposure indicators for occupational and environmental scenarios?
- What is the role of the human microbiome in exposure-induced inflammation (health endpoint)?
- How to better study and understand multiple exposures to multiple health endpoints?
- Need to understand the role of genetic predisposition to allergenicity.
- Improve data on dose-response and development of exposure thresholds.

### *Discussion question 2:*

- Literature review – how inflammation impacts mental disorders?
- Experiments to establish levels of exposure in different areas of the body – models also useful here (animal models/cell models/mechanistic/experimental/*in silico* – lots of options).
- Whole system vs specific pathways.
- What do we need to measure, in how much detail and for what purpose(s)?
- Need for sharing datasets.
- Need to better understand the interaction between biological/non biological component of BioPM and other air pollutants, and impact on viability, toxicity and infectivity of BioPM.
- Need for better interaction and collaboration between health and exposure scientists.



## Theme 4 Workshop: Policy and public engagement

This workshop was held on 12<sup>th</sup> March 2021. The event was attended by over 20 invited participants from industry, public bodies, practitioners and regulators. The focus was on how we can make BioPM science relevant and accessible, and how do we communicate to practitioners and the wider community. There were presentations from stakeholders (<https://bioairnet.co.uk/theme-4-workshop-policy-and-public-engagement/>) and interactive discussions with participants advancing our understanding of the public perception of BioPM risk and gauging their requirements and feedback to policy. The following three questions were discussed with participants:

**Discussion question 1:** How are BioPM relevant to you in your role and what issues arise out of this?

**Discussion question 2:** How do we communicate to practitioners and the wider community?

**Discussion question 3:** What further activities should be part of this Theme? How would you like to engage with the Network?

## Recommendations

### *Discussion question 1:*

The following topics and issues related to BioPM were identified by the participants that needed addressing and better communicating with stakeholders.

- Building design
- Building sustainability
- Green design/Blue-green infrastructure
- Air quality in prison
- Mechanical system for buildings
- Building regulations
- Relationship between indoor/outdoor air quality
- Modular construction and vulnerable households
- Buildings product development

### *Discussion question 2:*

- Raise awareness of the role of exposure to BioPM in different indoor/outdoor environments.
- Development of guidelines/briefs for specific stakeholders – practitioners, regulators and the public.



- Improve engagement with stakeholders (building industry, government and public bodies, regulators, professional bodies – RIBA, CIBSE).
- Need to improve engagement with media.
- Offer opportunities for education/training.
- Inclusion of BioPM in the school curriculum.
- Occupant's engagement for developing energy efficacy and health/wellbeing policies and guidelines.
- Need to involve public and local government to understand the problem and benefits of improving indoor air quality, particularly in social housing.

### *Discussion question 3:*

- Explore synergies with climate action agenda and potential exposure to BioPM across the indoor-outdoor continuum.
- Engagement with climate change groups.
- Focus on the long-term impact of building on flood plains in terms of flooding and resultant issues with BioPM.
- Involve the public in measuring air quality and demonstrating the impact of different activities on air quality.
- Develop training and dissemination materials (e.g. concept note, brief).
- Need to engage with the infrastructure planning department.
- Organising symposium or event on the matter.
- Develop a concept note on 'What a pandemic friendly building looks like' ?
- Provide a platform to share information on BioPM related issues.

## **Indoor Air Quality Association Australia webinar**

Zaheer Nasar from BioAirNet presented at the Indoor Air Quality Association Australia's Lunch & Learn Webinar on "Detection and characterisation of biological materials in airborne particles: Challenges and Opportunities". The recording is available at <https://www.iagaaustralia.org.au/lunch-learn-8-dr-zaheer-nasar-detection-and-characterisation-of-biological-materials-in-airborne-particles-challenges-and-opportunities/>.

## **Updates from other Networks**

### **TAPAS Network**

Following a successful first series of seminars available here (<https://tapasnetwork.co.uk/resources>), the TAPAS network launches its second series of lunchtime seminars on Thursdays, 1-2pm, from May 6th. Speakers include Xavier Querol from Spain's Institute of Environmental Assessment and Water Research, Nathan Wood from the Building Engineering



Services Association and Corinne Mandin from the Scientific and Technical Centre for Building. Details and registration details here: <https://tapasnetwork.co.uk/news-%26-events>.

## STFC Air Quality Network (SAQN)

The STFC Air Quality Network (SAQN) brings together an interdisciplinary community to find novel ways to address air quality challenges. We have funding available to enable access to the world class research capabilities of the Science and Technology Facilities Council (STFC) and work alongside STFC researchers. STFC expertise in sensor development, earth observation equipment, data handling, modelling and machine learning can all be applied to air quality challenges. Examples of STFC involvement in air quality research can be found on the [SAQN Scoping Studies webpage](#).

SAQN offers matchmaking services, linking researchers and industry with STFC experts. If you would like to find out more about how STFC could support your research, please [join the network](#) or email [fleur.hughes@york.ac.uk](mailto:fleur.hughes@york.ac.uk) for more information.

## Clean Air Day 2021 event

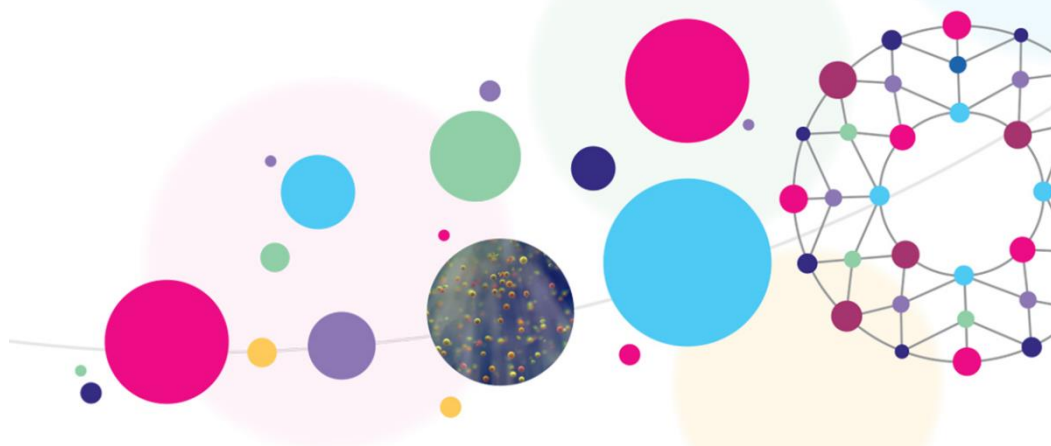
As a part of Clean Air Day 2021, an online event is organised jointly by the six UKRI SPF Clean Air Programme funded networks.

**Title: Communicating Clean Air Research**

**Date:** June 17, 2021

**Time:** 12:00 – 1:00 PM BST

It will be focused on how the academic community can engage and involve the wider public in clean air research. The event will be hosted by Prof Catherine Noakes, Professor of Environmental Engineering for Buildings at the University of Leeds. Registration link and details are available at <https://www.eventbrite.com/e/communicating-clean-air-research-tickets-156651792729>



## Get Involved

Please keep an eye on the upcoming events on BioAirNet website (<https://bioairnet.co.uk/>).

If you would like to share any news, events or funding opportunities with the network, please send them to [contact@bioairnet.co.uk](mailto:contact@bioairnet.co.uk)



<https://twitter.com/BioAirNet1>



<https://www.linkedin.com/groups/9015520/>

