Microplastics as a novel air pollutant: Challenges, implications and the future

Microplastics in the Ocean: Standards and Research Needs | 18th Oct 2019

Dr Stephanie Wright

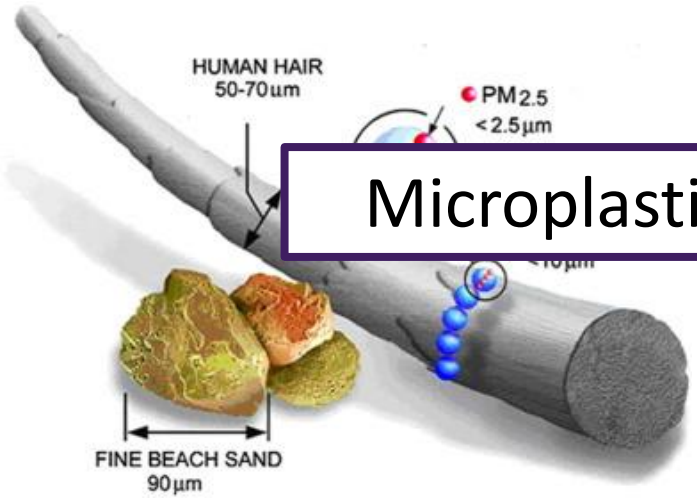
MRC Toxicology Unit

MRC Centre for Environment and Health

KING'S College LONDON

How did I end up here?

Exposure in the airway

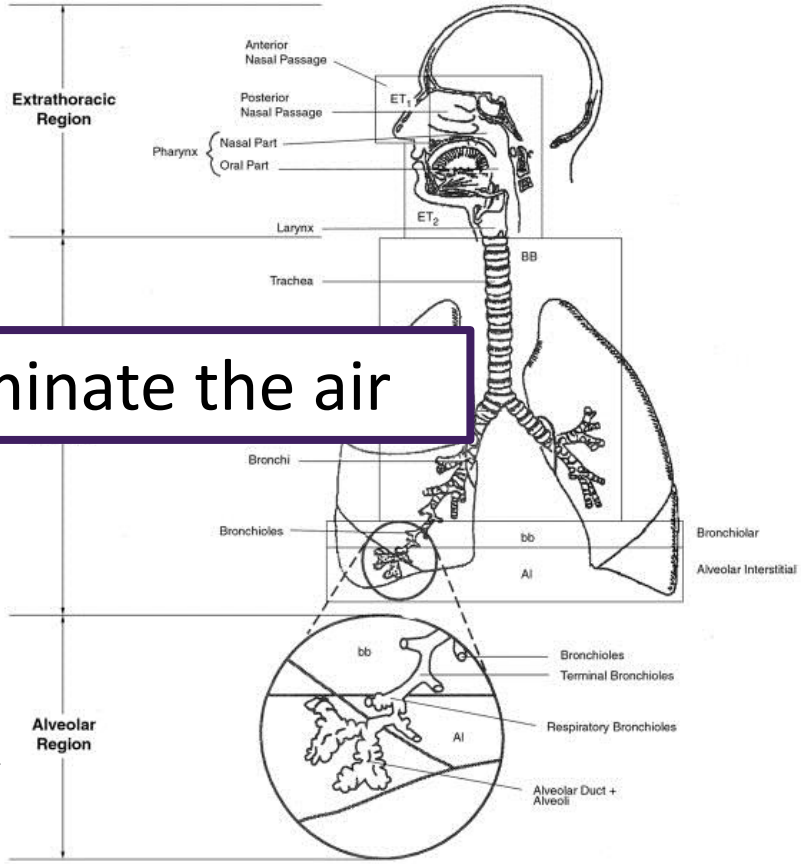


Microplastics contaminate the air

PM_{10}

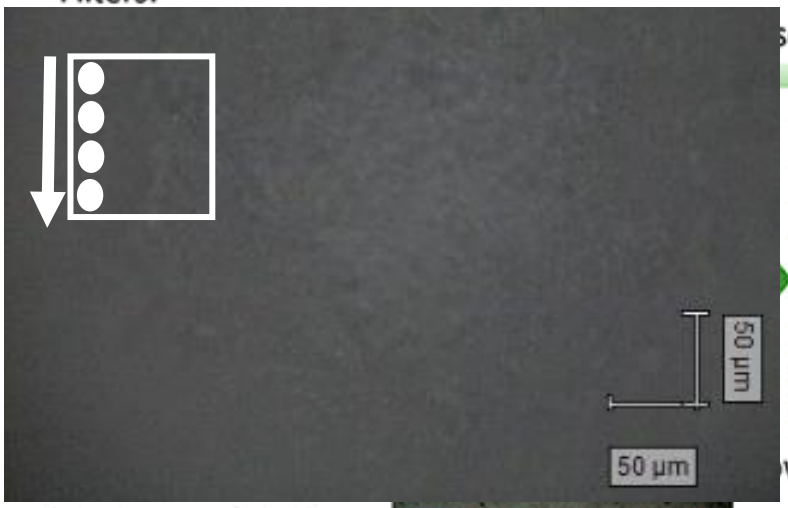
Fine $PM_{2.5}$

Ultrafine $PM_{0.1}$



Challenge: Can RSI be used to detect microplastics <10 µm?

Filters:



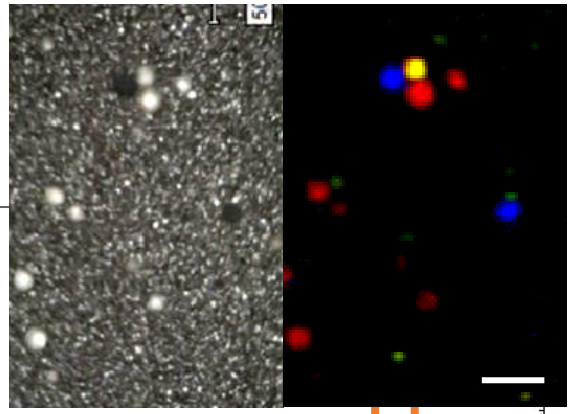
se | silver | alumina

w volume air sampler

4 h | 24 h

Polyethylene (PE, 10 – 27 µm)
Polystyrene (PS, 4 a 10 µm)
0.01% total concentration

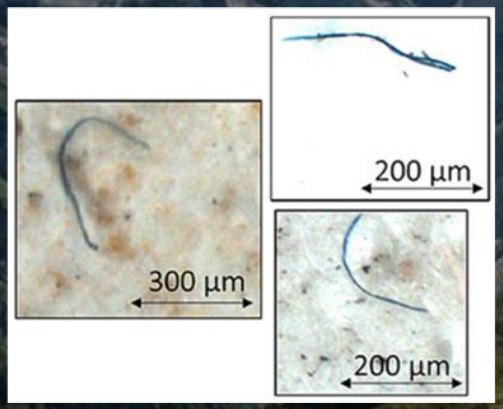
785 nm laser | 1
grating |



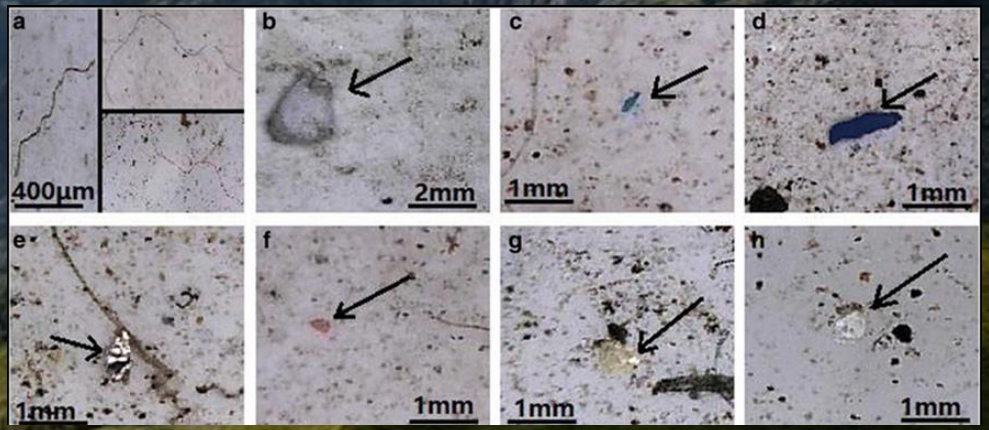
Wright et al., 201

Meanwhile…

365/m²/d



Dris et al. 2016.



Cai et al. 2017.

40/m²/d (size-adj)

95 km transport

Allen et al., 2019

Photo: peresanz/iStock

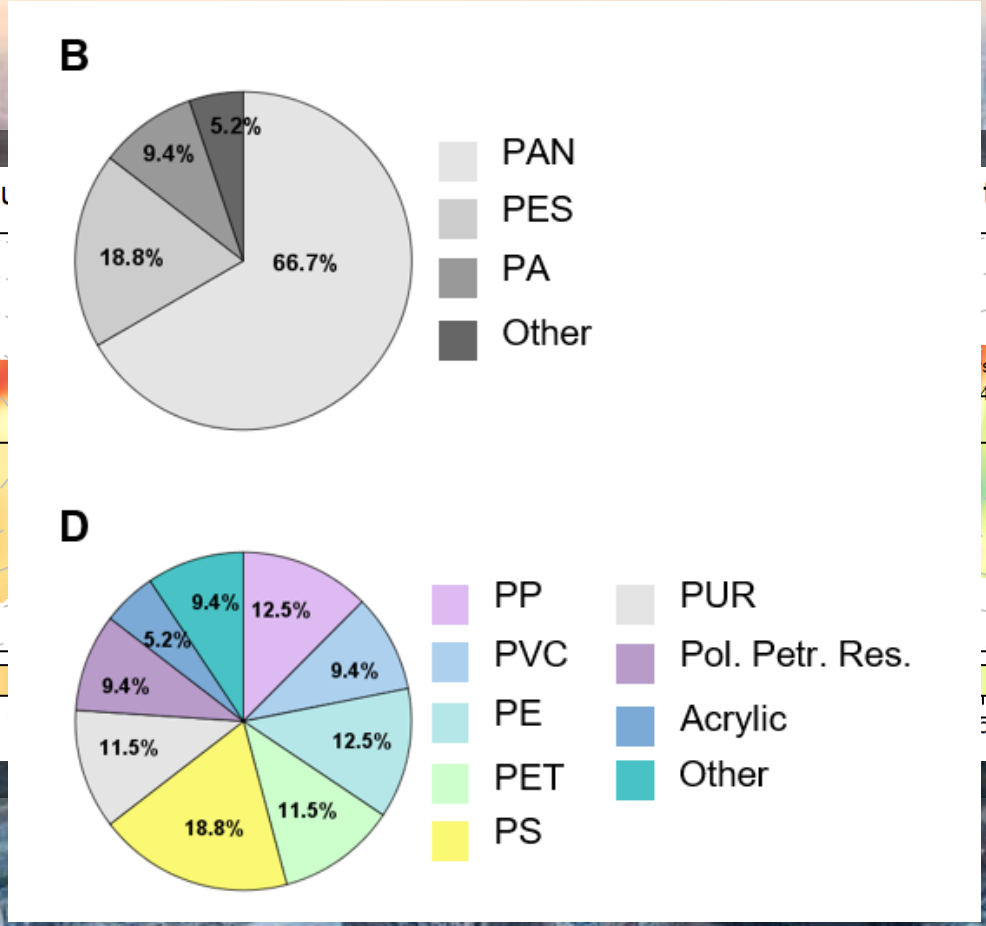
Challenge: are microplastics deposited from the atmosphere in urban London?

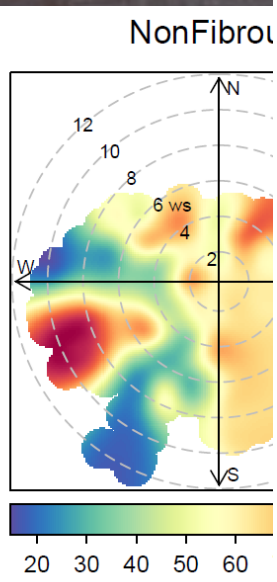
- 2x per week, 4 weeks (19th Jan – 16th Feb 2018)
- 3x 1L washes in succession
- Vacuum filtered onto silver membrane filters
  - Dried at 40 ˚C
- Nile Red staining (10 ug/L)
- Fluorescence microscopy/FTIR

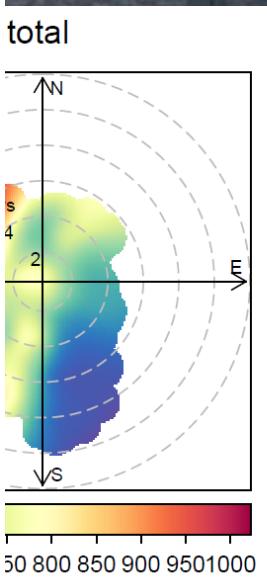
Wright, Ulke et al., 2019. In review.

712/m²/d

2 x 10^9 C. of London

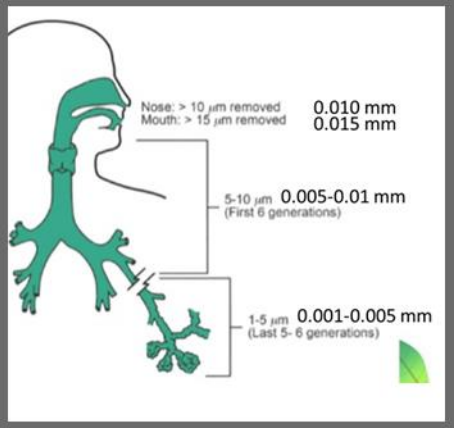


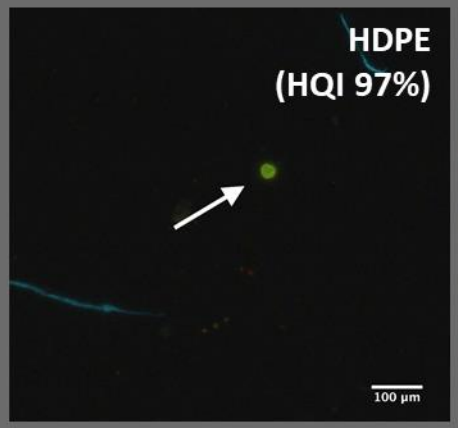


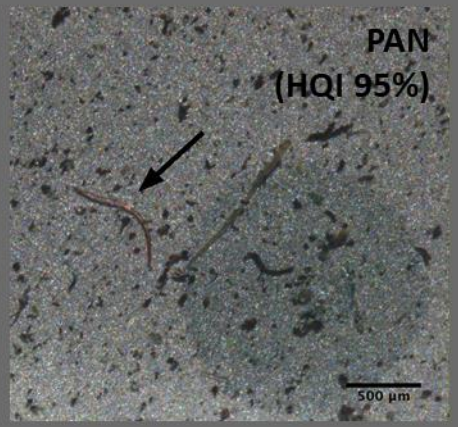


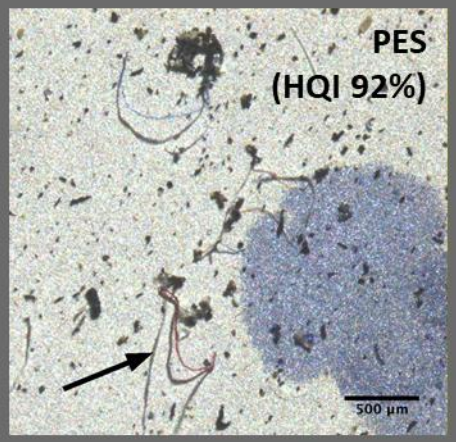
Wright, Ulke et al., 2019. In review.

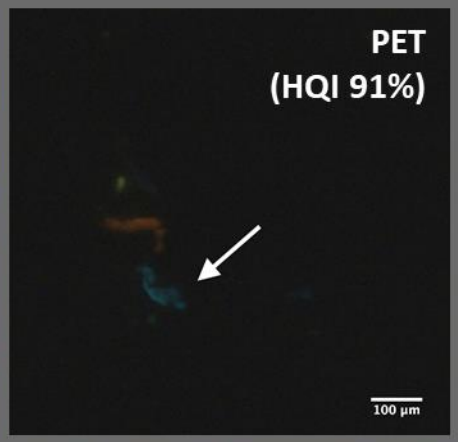
Photo: James Hawkes Aerial Photography

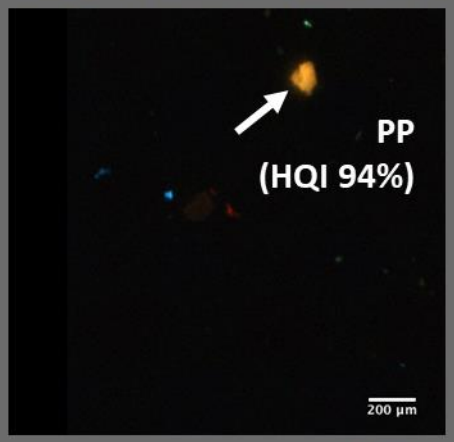


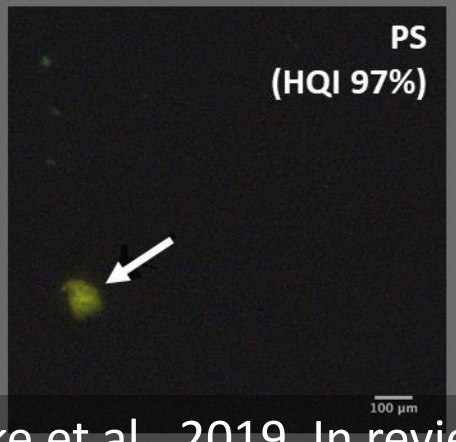


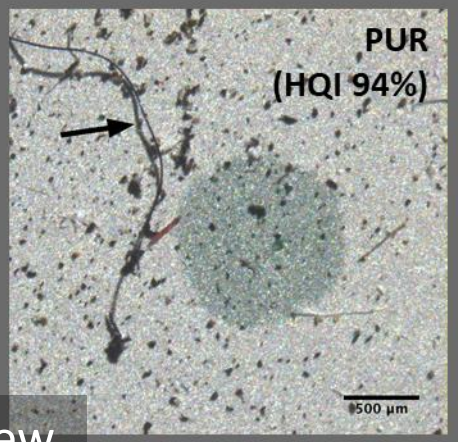


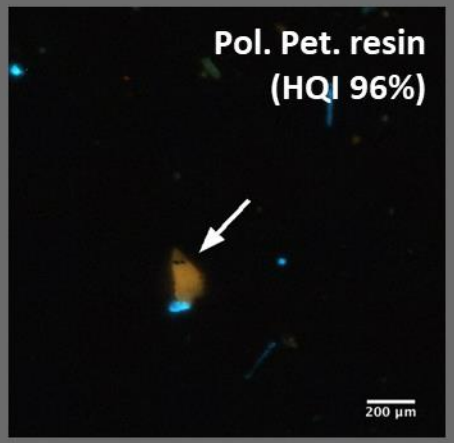






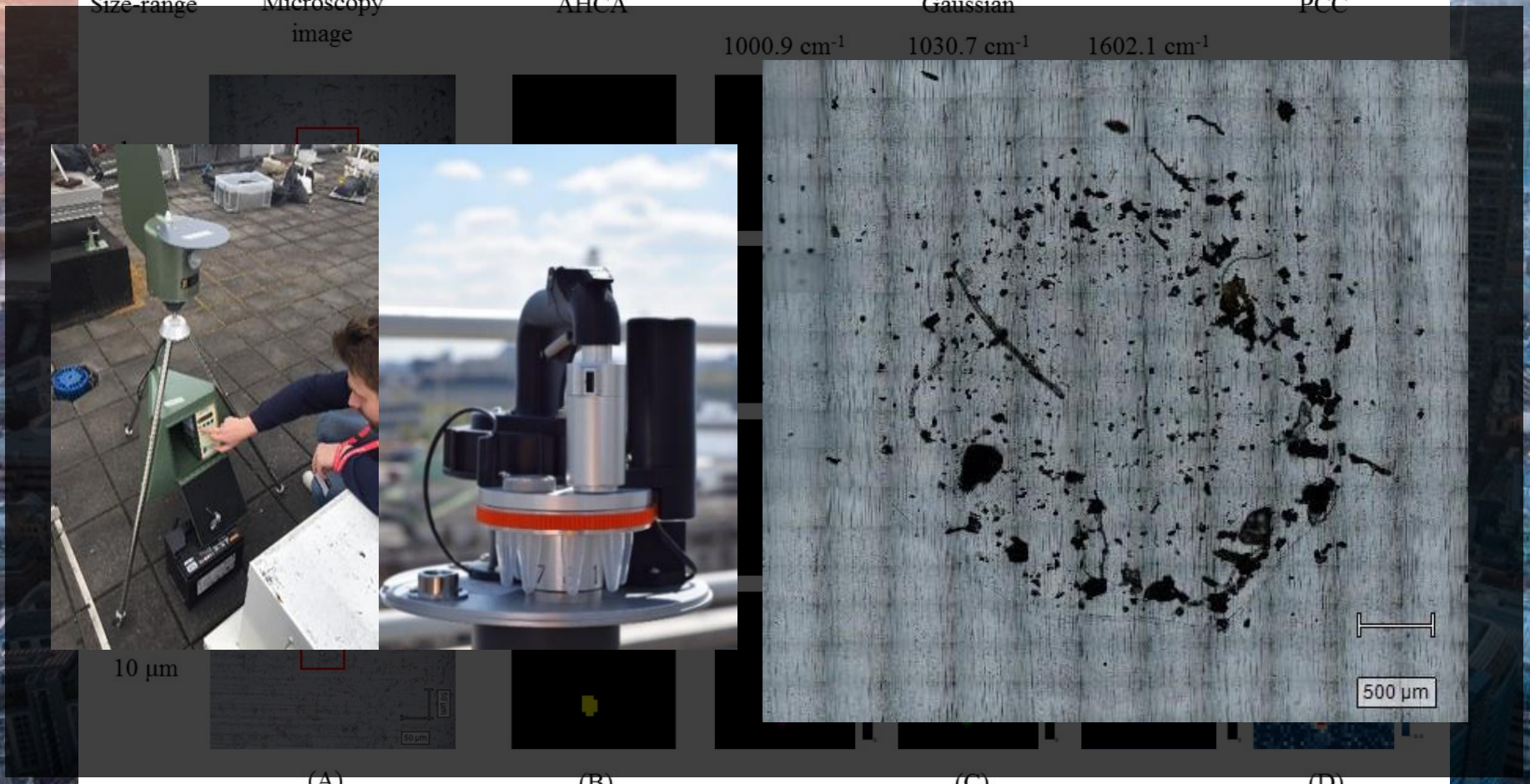






Wright, Ulke et al., 2019. In review.

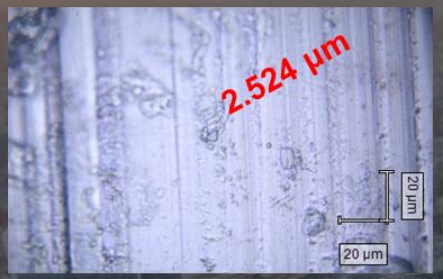
Challenge: Can we improve image analysis and LOD?

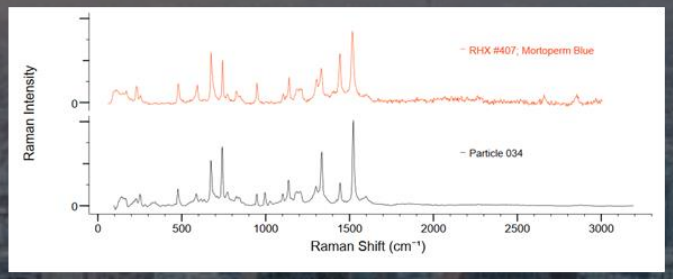


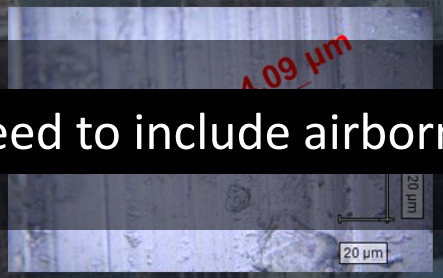
Levermore et al., 2019. *Submitted*.

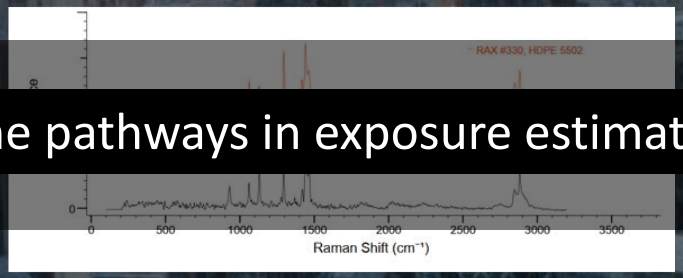
Photo: James Hawkes Aerial Photography

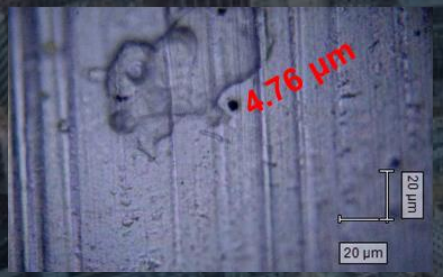
Challenge: Can we improve image analysis and LOD?

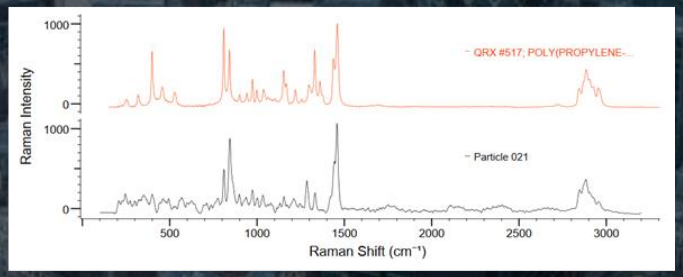












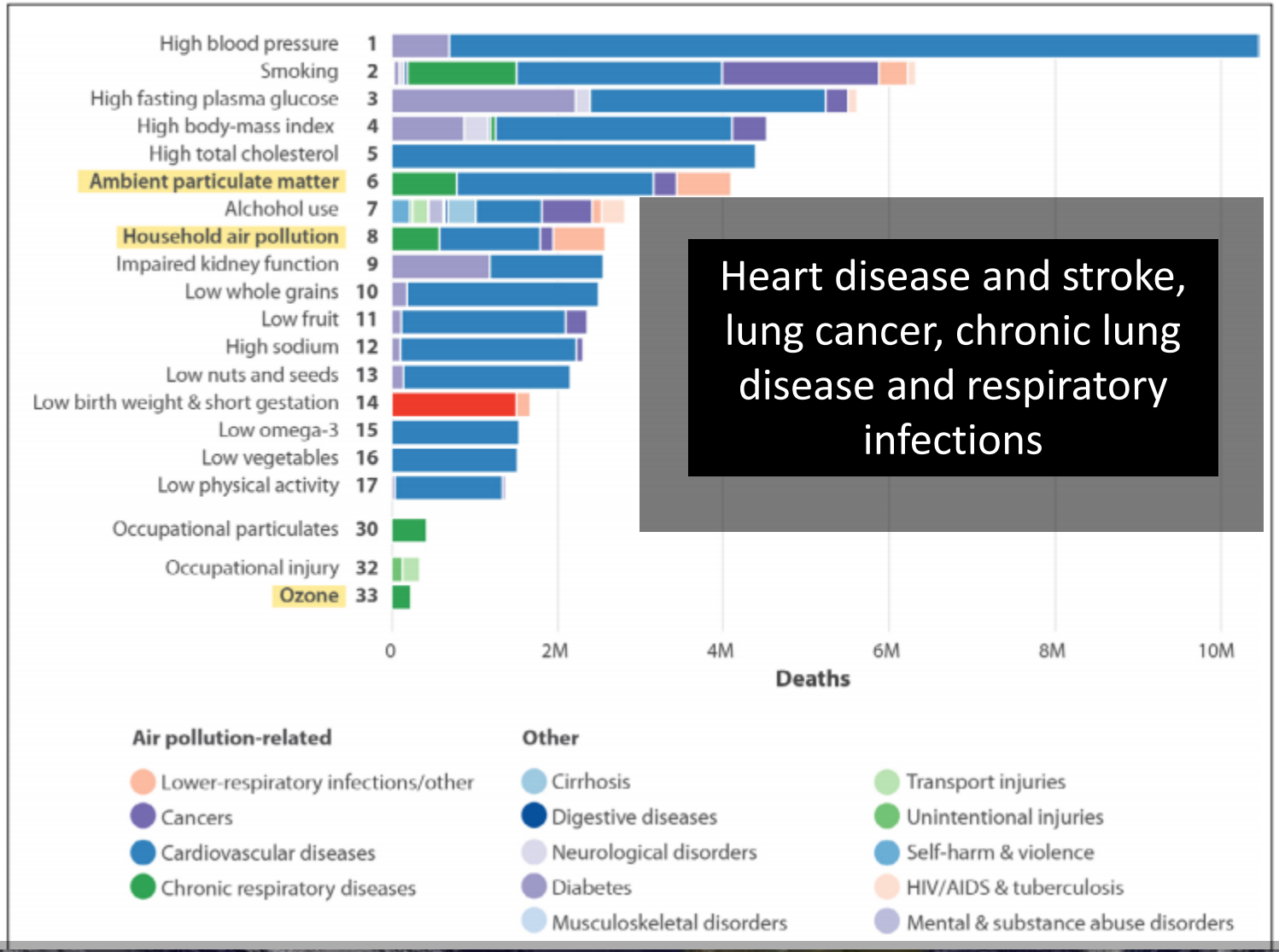
Need to include airborne pathways in exposure estimates.

Levermore et al., 2019. In prep.

Photo: James Hawkes Aerial Photography

Implications: Public health?

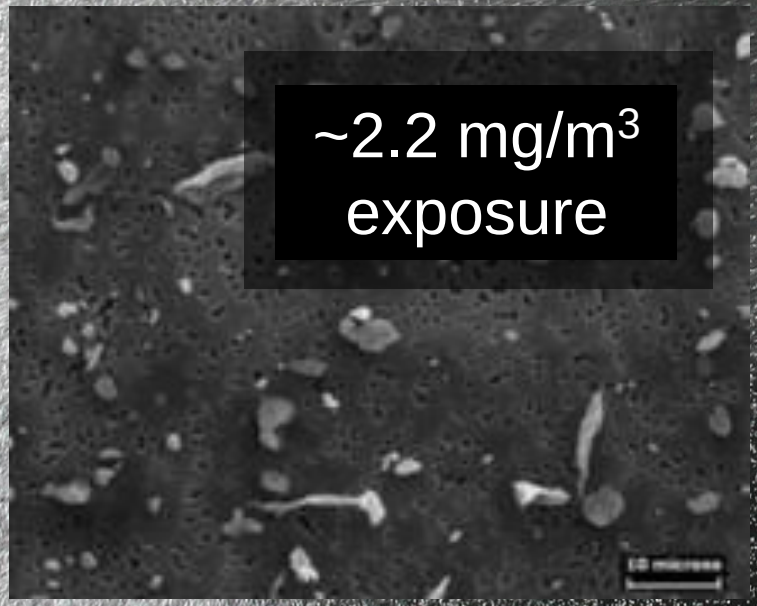
Figure 1. Global ranking of risk factors by total number of deaths from all causes for all ages and both sexes in 2016.



State of Global Air 2018, from Global Burden of Disease project of the Institute for Health Metrics and Evaluation.

Implications: Occupational disease

Flock Worker's Lung

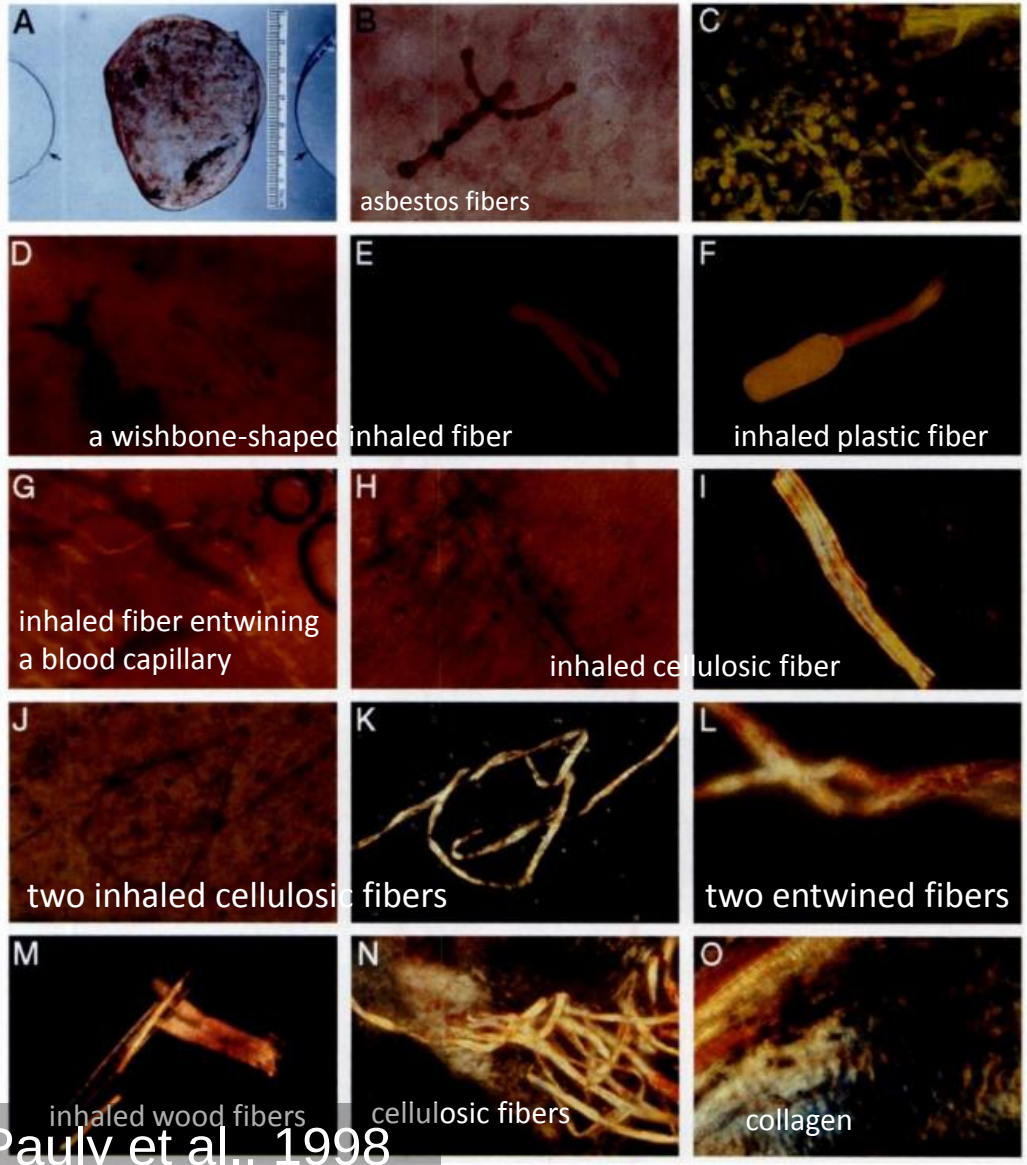


~2.2 mg/m^3 exposure

Inflammation, fibrosis

Kern et al. 1998, 2000, 2003; Burkhart et al., 1999

Future: Microplastic accumulation?



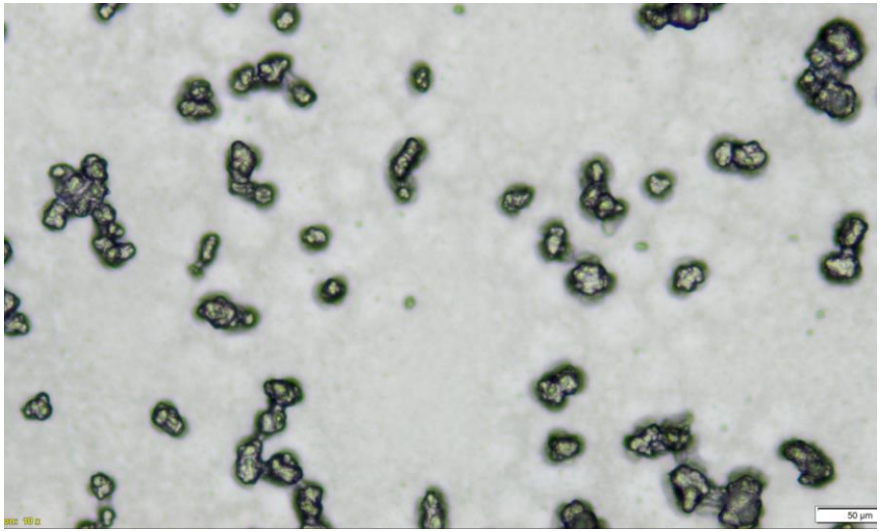
Pauly et al., 1998

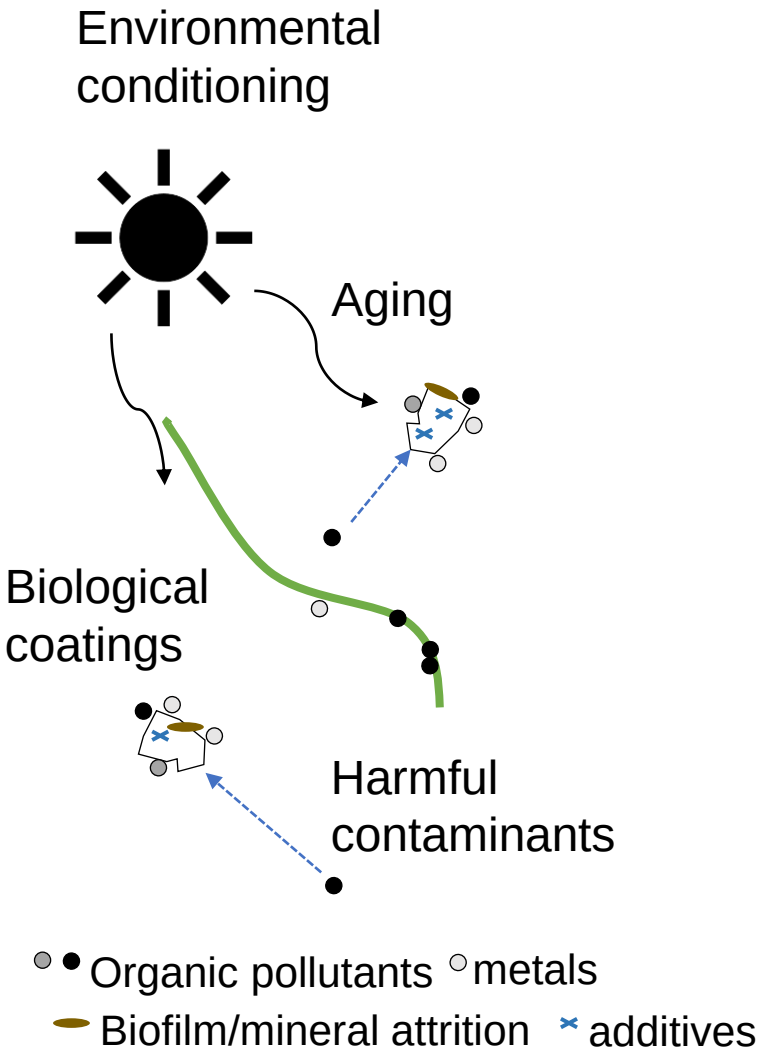
- 83% contained 1+ fibres
- 32/33 fresh malignant human lung tissue

- No diameters reported
- No scale bars
- No iron protein cover or foreign body reaction

Future: Microplastic toxicity?

- Cytotoxic dose response
- Bronchial epithelial cells
- Size-separated powders, spheres, fibres (comparing same polymers of different shapes)
- Nasal and alveolar; inflammation
- Aged v ‘fresh’
- NEGATIVE CONTROLS





Recommendations/Thoughts

- Fill the knowledge gaps re. microplastics <10 µm for exposure estimates (PM10 and PM2.5)
  - Micro-vibrational spectroscopy and TD- or py-GC/MS
- The right models and the right endpoints
- Negative controls – particle v plastic effects
- ‘Age’ may influence harmful parameters
- Mismatch in dialogue, e.g. human stools; single-use plastic

Thank you

KCL
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Mr Jannis Ulke

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Prof Marion MacFarlane
Dr John Le Quesne

PHE
Dr Rachel Smith
Dr Matthew Wright
Dr Tim Gantt

256,320,000,000,000,000

MRC-PHE Centre for Environment & Health
MRC Toxicology Unit
stephanie.wright@kcl.ac.uk