Airborne infection risk in complex urban environments: modelling, mapping and mitigation

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The COVID-19 pandemic has threatened the lives and livelihoods in the UK and globally. The widely used 2-m physical distancing guideline recommended by World Health Organization (WHO) and Public Health England (PHE) has been applied in indoors and outdoors to limit transmission of the virus between people. However, this recommendation may be inappropriate in complex urban environments with large variations of wind, air temperature and humidity. There is a need to develop a better understanding of airborne infection risk, safe physical distances and uncertainty associated with outdoor weather and urban environment information.

Supervisors with expertise in infection disease transmission (Luo), urban climate modelling (Grimmond), urban air pollution dispersion (Coceal) will work with the PhD student to explore:
1) what are the risks and the dynamic safe physical distancing thresholds for transmission of disease (e.g. COVID-19) in outdoor complex urban environments?
2) how does urban design influence the dispersion and evaporation of the human-generated droplets, and therefore their fate and infection risk?
3) what are effective mitigation solutions to reduce such infection risk in complex urban environments?
The student will have the opportunity to work with stakeholders to co-produce risk maps and mitigation guidelines for end-users.

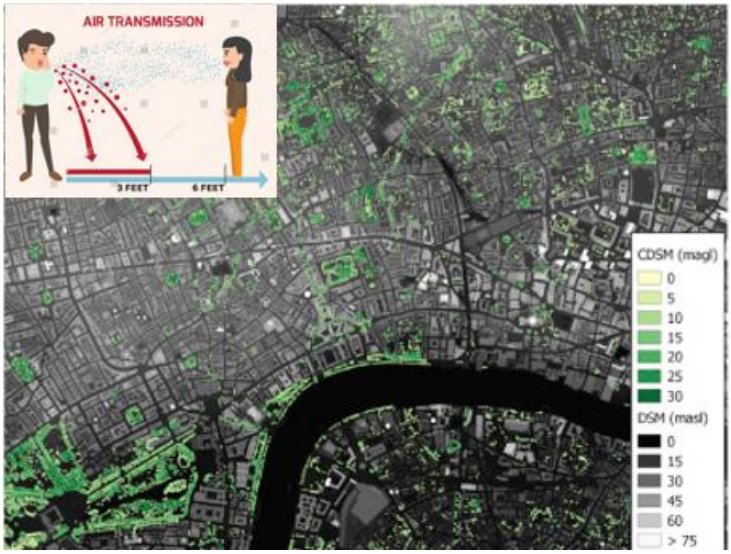

Figure 1. Integrating an airborne infection risk model into urban climate modeling framwork to understand the infection risk in urban enviornment (London as a case study)

Training opportunities:

- Courses in both Department of Meteorology and School of the Built Environment at the University of Reading, e.g., Healthy building design, Urban microclimate, Boundary layer meteorology.
- Placement at London Climate Change Partnership (GLA) to work with stakeholders to co-produce the products to be used by the end-users.
- Training in the urban meteorology group for research skills, programming, and presentation skills.
- Attend urban climate/urban physics summer school

Student profile: This project is suitable for students with a degree in physics, mathematics, meteorology or a closely related environmental or physical science. Good programming skills using Python, MATLAB, Fortran or other languages are desirable.

References:

- Liu et al. 2020: The impact of indoor thermal stratification on the dispersion of human speech droplets. Indoor Air http://dx.doi.org/10.1111/ina.12737
- Sun & Grimmond 2019: A Python-enhanced urban land surface model SuPy (SUEWS in Python, v2019.2): development, deployment and demonstration. Geoscientific Model Development https://doi.org/10.5194/gmd-12-2781-2019
- Hertwig et al. 2018: Evaluation of fast atmospheric dispersion models in a regular street network. Environ Fluid Mech 18, 1007–1044. https://doi.org/10.1007/s10652-018-9587-7