NATIONAL ANNUAL AVERAGE STREETSCALE RESOLUTION AIR QUALITY MODELLING

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Summary
The Multi-model Air Quality System for Health Research (MAQS-Health) focuses on coupling regional meteorological and chemical transport modelling (CTM) systems to a new road source dispersion model, ADMS-Local (Seaton *et al.*, 2022). Applications of this system may be limited to some extent by the availability of national modelled meteorological and concentration datasets. In view of this, MAQS-Health has been further developed to link to gridded annual average concentration datasets, such as the 1 km resolution gridded modelled background pollution datasets openly available from the UK government (Defra, 2022). This study presents the methodology and preliminary results from a national application of MAQS-Health.

Introduction
Key differences between the hourly CTM and annual MAQS-Health applications are summarised and source data requirements for national modelling are discussed. System predictions of annual average concentrations at a range of site types are evaluated allowing national regional-to-local scale pollutant concentration maps to be presented.

Methodology
The core calculation within MAQS-Health, that ensures no double counting of road source emissions, occurs once per grid cell for the annual average application, in contrast to every hour for the CTM application. However, ADMS-Local calculations remain at hourly resolution, so street-scale road source sector concentrations are temporally averaged prior to adding them to background values. For pollutants that are broadly unaffected by chemical processes over the spatial scales of one grid cell (i.e. NO_x, $PM_{2.5}$ and PM_{10}), the ADMS-Local calculations are performed independently of background concentration levels. NO_2 calculations are more complex due to the strong influence of non-linear NO_x chemistry on near-road concentrations, in particular the influence of O_3 on chemical processes must be allowed for. Thus monthly varying diurnal profiles of hourly average O_3 concentrations (usually from measurements) and hourly average NO_2 concentrations in photochemical equilibrium are used as background for the local calculations.

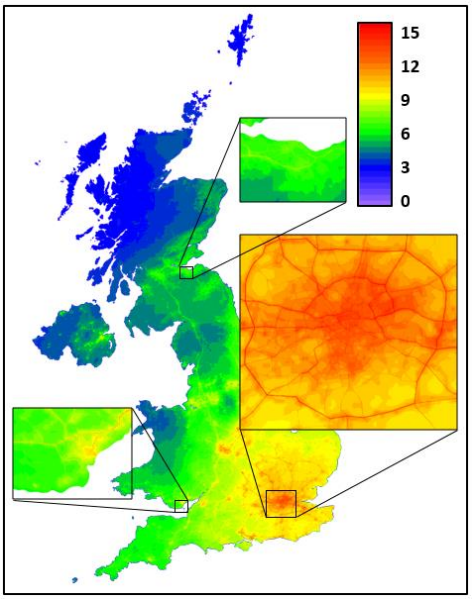

Fig.1 Modelled annual average $PM_{2.5}$: MAQS-Health application using UK government 1 km resolution 'background' concentration dataset (prelim. results for 2017)

Whilst near-road NO_2 and PM concentrations correlate with traffic emissions, complex urban morphology strongly influences pollutant dispersion; street canyons in particular have multiple effects on air movement and pollutant dispersion (e.g. flow channelling and recirculation). Therefore, estimates of street canyon parameters are required alongside major road emissions datasets for national modelling applications. These have been derived from openly available Local Climate Zone data for this study. The major road network emissions, derived from UK Department of Transport traffic count data, have been assigned to the Ordnance Survey Open Roads network. Hourly, 1 km resolution Weather Forecasting and Research (WRF) meteorological model data are used to drive the local modelling dispersion calculations.

Results
The evaluation of modelled concentrations is ongoing using the CERC's Model Evaluation Toolkit at all site types (rural, background and roadside); pollutants evaluated include: NO_x, NO_2, $PM_{2.5}$ and PM_{10}. Fig. 1 presents a preliminary national map of regional-to-local scale annual average $PM_{2.5}$ generated using this system.

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