Implementing a behaviour-based framework for studying the influence of cooking and cleaning on indoor air quality

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Introduction:

Indoor air quality (IAQ) is influenced by a cocktail of air pollutants emitted and formed *in situ* from a broad range of sources and human activity such as cooking and cleaning. Uncertainties remain in understanding the relationship between human behaviour and air pollutants emissions and dynamics, their emission source strengths and spatial variability in the residential buildings (Braniš et al., 2014; Nazaroff, 2016). A systematic approach to measuring the impact of indoor activities informed by human behaviour is extremely valuable and should allow the extrapolation of experimental findings.

Methods:

This novel study makes use of the UK Time Use Survey (UK-TUS) (Gershuny *et al.* 2017) to define a typology of activities for a typical day and explore how IAQ evolves with different behaviours by defining a framework for the systematic study of IAQ typical of the UK home. This framework is applied as a case study under low and high-ventilation scenarios.

A combination of established and low-cost particle measurements, trace gas analysers and novel bioaerosol sampling techniques are used in this study (Table 1). These are located in our sampling from a kitchen area with an internal volume of 29 m^3. Observations are compared with computational fluid dynamic (CFD) modelling carried out using Code_Saturne.

Measurement	Instrumentation
NO_2, NO_x, O_3	Trace gas analysers, low-cost sensors.
Aerosol size distributions, number concentrations and mass loadings.	Electrical Low Pressure Impactor (ELPI), MODULAIR-PM, NAQTS V2000, Nuwave PM sensors.
Bioaerosols	Online SIBS, viable bioaerosol sampler.
Meteorology and Irradiance	Met Station & Light Spectrometer

Table 1 Summary of Instrumentation

Results & Discussion:

We report preliminary results from cooking, cleaning and dish washing activities carried out in the DOMESTIC facility for studying human activity and air quality in the built environment at The University of Chester. DOMESTIC consists of a controlled chamber-like indoor space outfitted for studying cooking, cleaning and ventilation and associated instrumentation laboratory. We focus on results comparing sensor technologies, traditional methods, and modelling.

Figure 1 shows the preliminary analysis of the UK-TUS for food preparation and baking which is used to inform our study and define the cooking intervals and durations to be typical of a UK household. This data was used to determine typical durations of activities and their ranges which are used in the study.

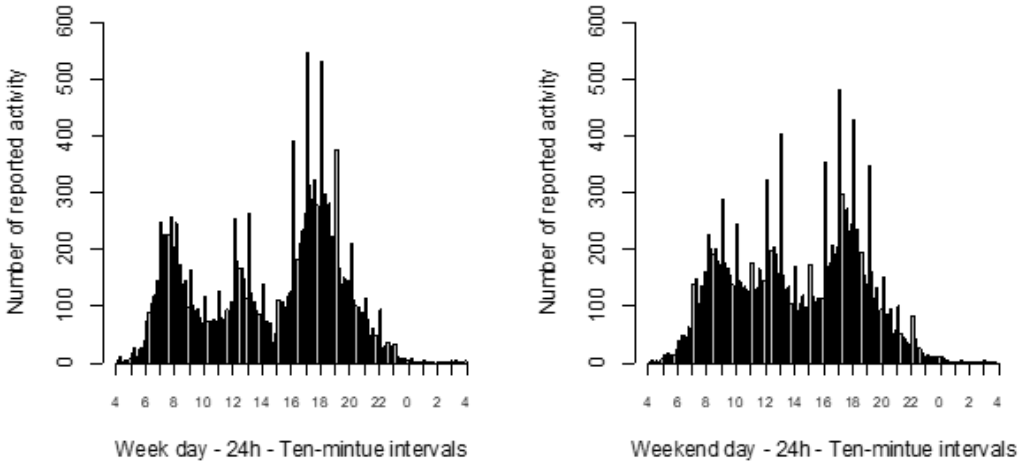

Figure 1 Frequency of food preparation and baking activities (left: week day, right: weekend day)

Conclusion:

This study offers insights into the interplay between human behaviour and studies of indoor air quality, using a well-defined framework based on the UK-TUS to explore cooking and cleaning activities, their influence on indoor air quality and occupant exposure. Analysis of the UK-TUS shows cooking activities are typically < 20 minutes, and cleaning is typically done in the morning. These have implications for the methodology used to the study IAQ.

References:

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