EXPOSURE VARIABILITY AND BEHAVIOUR OF INDOOR AND OUTDOOR AIR POLLUTANTS IN PRIMARY SCHOOLS IN THE UNITED KINGDOM

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Background and Aims

Current evidence suggests that exposure to common indoor air pollutants is associated with adverse health effects in children. This study was conducted to examine air quality in four primary schools in southern England, in order to establish daily, weekly and seasonal variability of pollutant concentrations within and between the schools, and to understand the behaviour of common indoor and outdoor air pollutants.

The present work is part of the SchoolAir study, conducted by the Brunel University team which overall aimed at assessing the relationship between indoor air quality in schools and the prevalence of asthma, respiratory and allergic symptoms among primary school children in four participating schools in the UK.

Methods

Four primary schools were selected for the study, suburban and rural environments with diverse size and socioeconomic backgrounds (schools S1-S3, R). Air quality monitoring was conducted in three rounds (autumn, winter, summer) during the academic year 2009-2010. Each round involved monitoring for one week in four locations typical of children's exposure, 3 indoors and 1 outdoors, during school day hours between 8:30 am and 15:45 pm.

Continuous (minute averages) measurements were carried out simultaneously for particulate matter count of size range 0.5-5.0μm ($PM_{0.5-5.0}$), carbon dioxide (CO_2), carbon monoxide (CO), nitrogen dioxide (NO_2) in all rounds, and formaldehyde (HCHO) and total volatile organic compounds (tVOC) only in the summer round.

Figure 1. A monitoring station in classroom during usual school day

Linear mixed models (LMM) were used to predict variability of indoor concentrations, based on contribution of outdoor concentrations to the same pollutant, ventilation measured by CO_2 concentrations and weather variables. Outdoor concentrations were predicted on weather variables.

Results

Findings showed important variability mainly for $PM_{0.5-5.0}$ and CO concentrations during the week and between rounds of measurements within each school, and between schools. CO_2 levels also differed depending on the daily activity patterns of children and practice of ventilation. Variable pollutant-pollutant correlations depended on site and activity patterns. Indoor/outdoor gradients were also found.

Figure 2. An example of $PM_{0.5-5.0}$ variability in two schools for two different days (Monday and Friday) in 3 locations

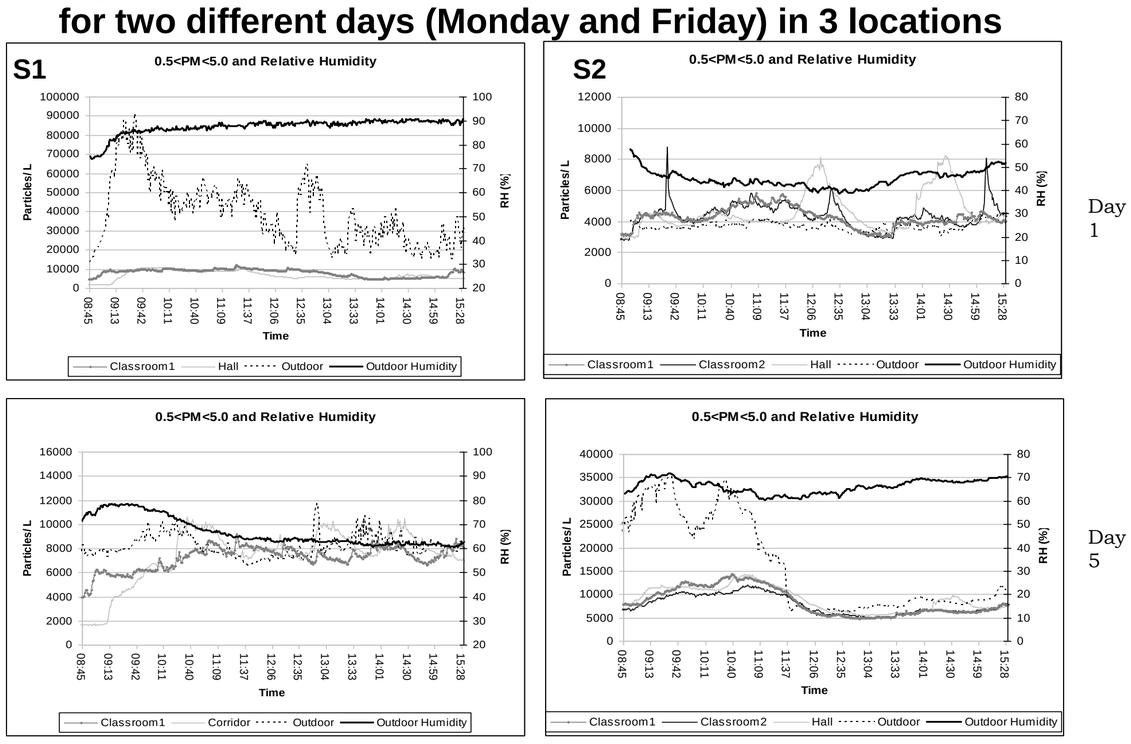
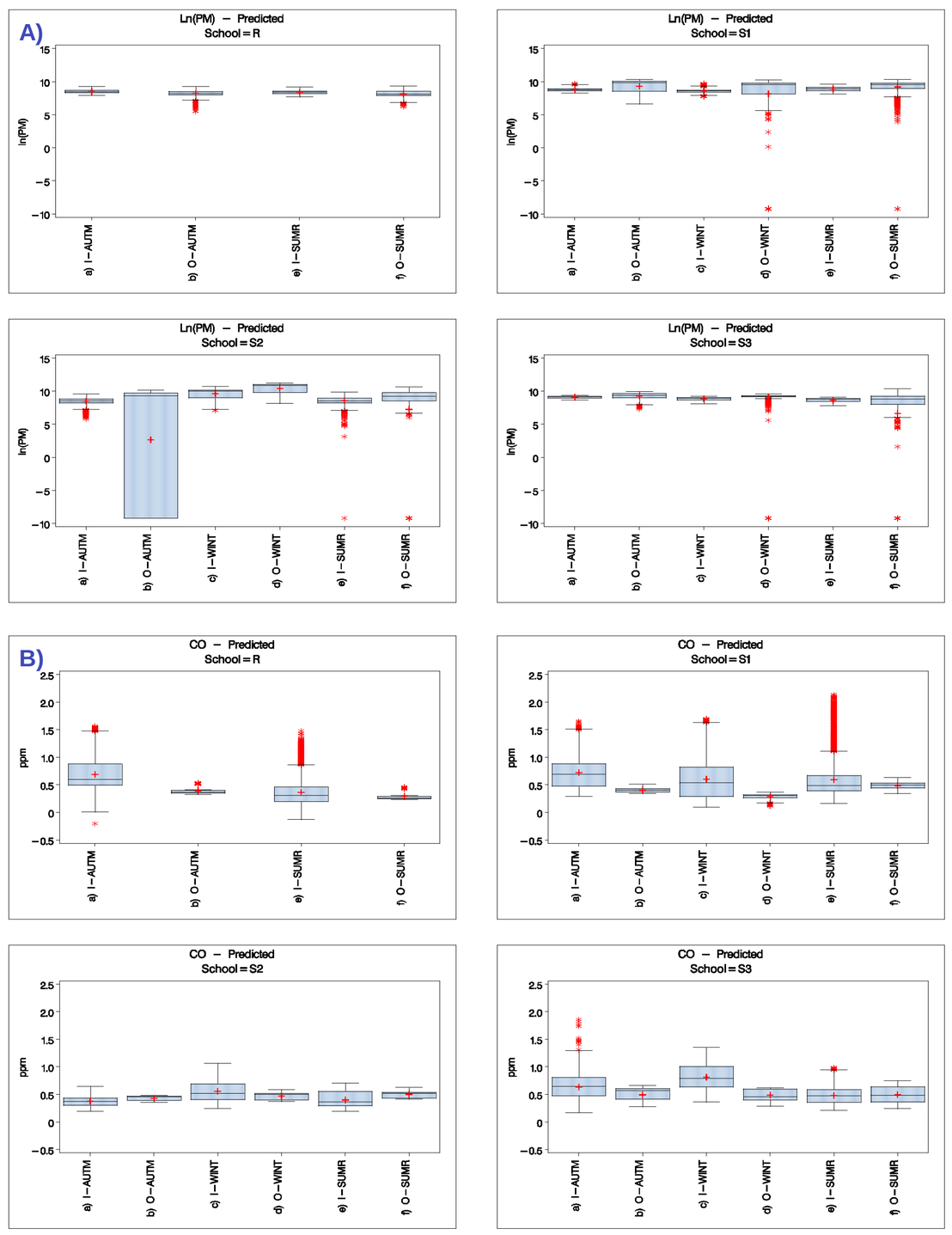


Figure 3. LMM predicted $PM_{0.5-5.0}$ (A, ln(particles/L)) and CO (B, ppm) concentrations for indoor/outdoor in three seasons



Conclusion

Study findings showed variability in pollutant exposure levels between locations, days and seasons in each school, and between all four schools. In particular, indoor variability related to school building design and location, outdoor concentrations, ventilation practices and children's daily activities. These findings support the need for developing methodology for personal exposure assessment to air pollutants among school children.

Acknowledgments

Expertise: Alan Reynolds, Brunel University, and Pat Goodman, DIT, Ireland, and special gratitude to all participating schools.