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Low-cost sensors to quantify activity-driven air pollution in indoor environments

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Indoor air quality is a dominant risk factor for human health, with many people spending approximately 80-90% of their time indoors. While outdoor infiltration, cooking, heating and cleaning sources are well known, human presence and activity through movement are harder to quantify and thus scarcely considered. This research investigates the relationship between occupancy, physical activity - defined by Kinetic Energy (KE), and particulate matter (PM) in real-world environments, including homes and offices. Our methodology uses a sensing network that combines low-cost air quality sensors with high-resolution radar-based motion sensors. Through this approach, we apply both simple linear regression and source apportionment modelling to define and isolate the contribution of KE-induced resuspension from indoor sources, thereby quantifying the contribution of human activity on indoor air quality levels. The first results, published recently (Bousiotis et al. 2026), establishes a significant correlation between KE thresholds and coarse particle mass (up to r = 0.74), suggesting that human-induced PM_{10} is a significant, yet under-quantified, contributor to personal exposure. In our current and upcoming work, we provide an update on the analysis for multiple residential and office environments, and go further by analysing the contribution of human movement to $PM_{2.5}$ levels. By considering the 'person-as-a-source' dynamic, this research provides a scalable framework for improving indoor air quality management through low-cost, high-resolution environmental sensing, whilst contributing to the evidence base for healthier building design.

Bousiotis D., D.S. Sanghera, J. Carrington, G. Hodgkiss, F. Jajarmi, K. Rajab and F.D. Pope (2026) Parameterising the effect of human occupancy and kinetic energy on indoor air pollution. *npj Climate and Atmospheric Science.* https://www.nature.com/articles/s41612-025-01281-9