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Effect of ventilation settings on PM2.5 and CO_2 concentrations inside public transit double-decker buses

Zhiyuan Li (1), Wenwei Che (1), H. Christopher Frey (1,2), Jimmy C.H. Fung (1), and Alexis K.H. Lau (1)
(1) The Hong Kong University of Science and Technology, Hong Kong , (2) North Carolina State University, United States

PM2.5 concentration in public transport microenvironments (e.g., bus in-cabin) may have significant influence on commuters' overall exposure. To date, there are few data on the influence of ventilation settings on bus in-cabin PM2.5 concentrations. This study aims to evaluate the spatial distribution of PM2.5 and CO_2 concentrations inside transit double-decker buses under two ventilation modes in Hong Kong. Two ventilation setting options, the outside air intake (OA) ventilation mode and the recirculation (RC) ventilation mode, were compared. Four sets of portable air samplers were deployed at three positions inside the bus (upper duct, upper deck, and lower deck) and the outside position of the bus to measure PM2.5 and CO_2 concentrations simultaneously in January 2016. Results showed that the Electrostatic Air Cleaner (EAC) in the air conditioning system plays an important role in maintaining bus in-cabin PM2.5 concentration at a relatively low level. The average bus in-cabin PM2.5 concentrations at the three positions were significantly lower than the outdoor concentrations, with average in-cabin/outdoor (I/O) ratios lower than 0.5. Bus in-cabin PM2.5 concentration under OA ventilation mode is more influenced by outdoor air than under RC ventilation mode, as evidenced by higher correlation between bus in-cabin PM2.5 and outdoor PM2.5 and higher PM2.5 I/O ratios. Compared with upper deck and lower deck, upper duct PM2.5 concentration is more influenced by outdoor PM2.5, with average I/O ratios 2.3 to 3.4 times higher. The average bus in-cabin CO_2 concentration under RC ventilation mode tends to be approximately 2 times higher than under OA ventilation mode. This study highlights the bus in-cabin spatial distribution of PM2.5 and CO_2 concentrations under two ventilation settings, which helps more accurately assess bus commuting PM2.5 exposure, and provides insights for a tradeoff between CO_2 concentration accumulation and PM2.5 concentration reduction inside the buses.