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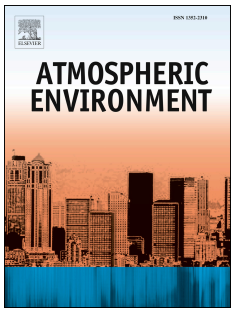

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Modelling photochemical pollutants in a deep urban street canyon: Application of a coupled two-box model approximation

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Abstract:

Air pollution associated with road transport is a major environmental issue in urban areas. Buildings in urban areas are the artificial obstacles to atmospheric flow and cause reduced ventilation for street canyons. For a deep street canyon, there is evidence of the formation of multiple segregated vortices, which generate flow regimes such that pollutants exhibit a significant contrast between these vortices. This results in poor air ventilation conditions at pedestrian level, thereby leading to elevated pollutant levels and potential breaches of air quality limits. The hypothesis of a well-mixed deep street canyon in the practical one-box model approach is shown to be inappropriate. This study implements a simplified simulation of the canyon volume: a coupled two-box model with a reduced chemical scheme to represent the key photochemical processes with timescales similar to and smaller than the turbulent mixing timescale. The two-box model captures the significant pollutant contrast between the lower and upper parts of a deep street canyon, particularly for NO_2. Core important parameters (i.e. heterogeneity coefficient, exchange velocity and box height ratio) in the two-box model approach were investigated through sensitivity tests. The two-box model results identify the emission regimes and the meteorological conditions under which NO_2 in the lower canyon (i.e. the region of interest for the assessment of human health effects) is in breach of air quality standards. Higher NO_2 levels were observed for the cases with higher heterogeneity