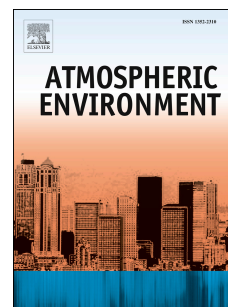


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Modelling photochemical pollutants in a deep urban street canyon: Application of a coupled two-box model approximation

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2 **Application of a coupled two-box model approximation**

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8 **Abstract:**

9 Air pollution associated with road transport is a major environmental issue in urban areas. Buildings
10 in urban areas are the artificial obstacles to atmospheric flow and cause reduced ventilation for
11 street canyons. For a deep street canyon, there is evidence of the formation of multiple segregated
12 vortices, which generate flow regimes such that pollutants exhibit a significant contrast between
13 these vortices. This results in poor air ventilation conditions at pedestrian level, thereby leading to
14 elevated pollutant levels and potential breaches of air quality limits. The hypothesis of a well-mixed
15 deep street canyon in the practical one-box model approach is shown to be inappropriate. This study
16 implements a simplified simulation of the canyon volume: a coupled two-box model with a reduced
17 chemical scheme to represent the key photochemical processes with timescales similar to and
18 smaller than the turbulent mixing timescale. The two-box model captures the significant pollutant
19 contrast between the lower and upper parts of a deep street canyon, particularly for NO₂. Core
20 important parameters (i.e. heterogeneity coefficient, exchange velocity and box height ratio) in the
21 two-box model approach were investigated through sensitivity tests. The two-box model results
22 identify the emission regimes and the meteorological conditions under which NO₂ in the lower
23 canyon (i.e. the region of interest for the assessment of human health effects) is in breach of air
24 quality standards. Higher NO₂ levels were observed for the cases with higher heterogeneity

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