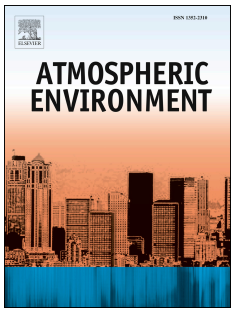
Accepted Manuscript



A cost-effective method for simulating city-wide air flow and pollutant dispersion at building resolving scale

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PII: S1352-2310(17)30162-0

DOI: 10.1016/j.atmosenv.2017.03.030

Reference: AEA 15241

To appear in: *Atmospheric Environment*

Received Date: 25 July 2016

Revised Date: 15 March 2017

Accepted Date: 17 March 2017

Please cite this article as: Berchet, A., Zink, K., Muller, C., Oettl, D., Brunner, J., Emmenegger, L., Brunner, D., A cost-effective method for simulating city-wide air flow and pollutant dispersion at building resolving scale, *Atmospheric Environment* (2017), doi: 10.1016/j.atmosenv.2017.03.030.

A cost-effective method for simulating city-wide air flow and pollutant dispersion at building resolving scale

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Abstract

A cost-effective method is presented allowing to simulate the air flow and pollutant dispersion in a whole city over multiple years at the building-resolving scale with hourly time resolution. This combination of high resolution and long time span is critically needed for epidemiological studies and for air pollution control, but still poses a great challenge for current state-of-the-art modelling techniques. The presented method relies on the pre-computation of a discrete set of possible weather situations and corresponding steady-state flow and dispersion patterns. The most suitable situation for any given hour is then selected by matching the simulated wind patterns to meteorological observations in and around the city. The catalogue of pre-computed situations corresponds to different large-scale forcings in terms of wind speed, wind direction and stability. A meteorological model converts these forcings into realistic mesoscale flow patterns accounting for the effects of topography and land-use contrasts in a domain covering the city and its surroundings. These mesoscale patterns serve as boundary conditions for a microscale urban flow model which finally drives a Lagrangian air pollutant dispersion model. The method is demonstrated with the modelling system GRAMM/GRAL v14.8 for two Swiss cities in complex terrain, Zurich and Lausanne. The mesoscale flow patterns in the two regions of interest, dominated by land-lake breezes and driven by the partly steep topography, are well reproduced in the simulations matched to in situ observations. In particular, the combination of wind measurements at different

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