

Quantitative assessment of an urban canyon resistance network through large-eddy simulations of wall-heated scenarios

Cai, Xiaoming

License:

None: All rights reserved

Document Version

Publisher's PDF, also known as Version of record

Citation for published version (Harvard):

Cai, X 2013, Quantitative assessment of an urban canyon resistance network through large-eddy simulations of wall-heated scenarios. in *EMS Annual Meeting Abstracts*. vol. 10, EMS Publishing House, 13th EMS Annual Meeting / 11th ECAM, Reading, United Kingdom, 9/09/13.

[Link to publication on Research at Birmingham portal](#)

General rights

Unless a licence is specified above, all rights (including copyright and moral rights) in this document are retained by the authors and/or the copyright holders. The express permission of the copyright holder must be obtained for any use of this material other than for purposes permitted by law.

- Users may freely distribute the URL that is used to identify this publication.
- Users may download and/or print one copy of the publication from the University of Birmingham research portal for the purpose of private study or non-commercial research.
- User may use extracts from the document in line with the concept of 'fair dealing' under the Copyright, Designs and Patents Act 1988 (?)
- Users may not further distribute the material nor use it for the purposes of commercial gain.

Where a licence is displayed above, please note the terms and conditions of the licence govern your use of this document.

When citing, please reference the published version.

Take down policy

While the University of Birmingham exercises care and attention in making items available there are rare occasions when an item has been uploaded in error or has been deemed to be commercially or otherwise sensitive.

If you believe that this is the case for this document, please contact UBIRA@lists.bham.ac.uk providing details and we will remove access to the work immediately and investigate.



Quantitative assessment of an urban canyon resistance network through large-eddy simulations of wall-heated scenarios

X.-M. Cai

University of Birmingham, School of Geography, Earth & Environmental Sciences, United Kingdom (x.cai@bham.ac.uk)

It is a challenging task to find an appropriate temperature boundary condition for a meso-scale meteorological model over a heated urban surface because of extremely complicated turbulent and thermo-dynamical processes inside the urban canopy layer. Often the urban canyon resistance network (UCRN) approach is adopted to provide a simplified solution to it. Such a UCRN model normally consists of multiple boxes (representing layers / volumes of air and urban facets) that are inter-connected by resistances. However, knowledge of the resistances is poor due to lack of observational data and the complexity in the processes of heat transfer in/above urban canopy layer. In order to address the fundamental issue, a modelling methodology is adopted based on large-eddy simulation (LES) of the urban surface layer over a heated street canyon. A new wall-function for temperature is constructed using existing knowledge of heat transfer over a rough facet and implemented in a LES model. A set of wall heating scenarios (either the upstream or downstream wall is heated) has been simulated. The LES output has been analysed in order to assess the heat transfer characteristics near the urban facets and the magnitudes of resistances in a UCRN. This study reveals that the near-facet resistance is the highest one in the UCRN, and thus has the greatest influence on the heat flux. In other words, the heat transfer process in the near facet region plays a far more important role than that at the top of the urban canopy. In addition, the value of the near-facet resistance depends on the local turbulent convection regimes (force convection, natural convection, or mixed convection). Therefore, the future research on the flux-temperature relationship over a heated urban surface should be focused primarily on the quantification of the near-facet resistance for various rough urban facets in different convection regimes.