Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2015-955-RC2, 2016

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Sensitivity of urban boundary layer dynamics to surface characteristics of built terrains" *by* Jiyun Song and Zhi-Hua Wang

Anonymous Referee #1

Received and published: 21 March 2016

An advanced stochastic approach is presented to evaluate the sensitivity of a numerical model framework with offline setup. While the numerical approach is promising and could advance knowledge on the implications of set model parameters, the conclusions drawn about the model parameters are mostly not new.

General comments:

- This is not the first time model parameters are evaluated with such a stochastic approach. More insights should be provided on existing literature on this area of research. The open questions and uncertainties should be listed and addressed specifically. It should be clearly stated why certain parameters are being tested.

- The conclusions drawn on the sets of model parameters are mostly to be expected and often directly obvious from the equations. The analysis should be rephrased so that these findings are not presented as if they were new results. Rather the benefits of the stochastic approach compared to other techniques should be emphasized. The conclusions sections should be rephrased accordingly.

- It would also be appropriate to change the title to put the emphasize on the methodology rather than the parameter testing as this is the more relevant/new contribution of this work.

specific comments:

P1, l18: Be careful with such statements: 'fraction of paved/vegetated terrains imposes more significant impact than the urban morphology'. When comparing different drivers for conditions in the atmospheric boundary layer, it is difficult to draw such generalized conclusions. In this study, extremely high fractions of irrigated green roofs are tested which will naturally have a big impact. It would have to be evaluated how much the morphology would have to change to achieve similar effects in order to make such a direct, generalized comparison.

P1, l27: Make clear this is referring to the model setup: 'coupled' land-atmosphere processes?

P2, l9: should 'boundary characteristics' rather be 'boundary conditions'?

P2, l12: State which studies in the literature have used similar approaches to simulate the impact of varying input parameters, i.e. changing multiple parameters simultaneously. Which are the open research questions this study is aiming to address?

P2, l15: define 'uncertain parameters'

P2, l19: check grammar

P2, l29: explain what is meant by 'sensitive quantification'

P3, l19: comment on advection, i.e. that it is not represented by the used setup

P3, l21: what about the heat storage in the air volume within the street canyons?

P4, l4: where is the 'top of the surface layer'? mention blending height concept

P4, l25: repetition with line 8

P6, l12: Which database do the surface station data come from? How did you estimate the footprint of the radiosonde?

P6, l16: To draw the conclusion that turbulent surface fluxes are also evaluated by the good agreement with the radiosonde profiles includes a series of assumptions. Also comment on the differences between observations and model profiles in the lowest layers where surface fluxes will have the most impact.

P7, l22: What exactly is meant by 'calibrated' input parameters? Are all roofs at mean roof height or is some variability assigned to the roof height?

P7, l24: Why did you choose such high soil moisture levels?

P7, l27: Comment why these specific parameters were selected/ why the others are considered less critical.

P7, l30: How did you select physically realistic parameter space for uncertain parameters? Based on literature? Representing a specific type of city?

P7, l32: By 'dimensional parameters' you mean morphometric?

P8, l1: How did you set uniform distribution for entrainment rate and lapse rate?

P8, l24: with 'log concavities' you are referring to the shape of the curves? Maybe this could be re-phrased to me something more descriptive.

P9, l23: As Table 3 and Figure 7 have the same content, the table could be moved to supplementary material?

P9 l24: Normalised roof width not included in Table 1. Is a change in roof width connected to a change in plan area fraction?

P10, l2-13: move to introduction

P10, L23: According to Table 1, aerodynamic resistance appears to be a set input parameter. Here you mention it to be a function of surface roughness. If this is the case this should be mentioned in the methods section.

P11, l29: Careful: most green roofs are constructed to be extensive, i.e. that they would not require irrigation but would use only natural water from precipitation. Comment on the representativeness of your model setup.

P11, l32: this sentence is difficult to read. What is meant by 'detailed boundary layer physics ... require further investigation'?

P12, l10: Are these results integrated over the whole day?

P12, l19: Provide reference for the Zm – Zh relation

P12, l23: Given resistances are directly related to turbulent fluxes, this is not a surprising result. Altering the roughness length is a fundamental change to urban morphology. Especially as roughness characteristics of individual facets combine to the local scale roughness.

P12, last paragraph: these observations are directly related to the governing equations and should not be presented as new results.

P13, l1-7: This paragraph and Figure 10 seem a bit out of place. Does this belong to the discussion of roughness? Maybe this should be moved to an earlier section.

P13, l17: It seems a bit exaggerated to conclude extensive irrigation of large amounts of green roofs are linked to 'better management of urban water cycles'

P13, l19: The combined impact of radiation trapping and shadows on the heating of

urban surfaces is not a new finding of this study.

P13, l24: Be careful, talking about effectiveness of changing morphometric conditions of the urban surface. The model setup used here is very simple and limited conclusions can be drawn on the effect of altered surface roughness of a real urban canopy.

- Check unites of roughness length in Table 2

- Include in Table caption of Table 3: 'For definition of symbols and units wee Table 1'

Technical comments

- check use of articles

- singular and plural forms often mixed up

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