Atmospheric
Chemistry
and Physics
Discussions

ACPD

Interactive
comment

Interactive comment on "Effects of Urbanization on Regional Meteorology and Air Quality in Southern California" *by* Yun Li et al.

Anonymous Referee #2

Received and published: 5 December 2018

Dear authors, The paper is well written and clearly structured, however I would recommend a number of major changes in order to be suitable for publication. Please find my comments below:

General: I see a general problem in the definition of the scope of the study. A 'before human settlement' scenario should not consider emissions at all and further describes a period about ∼100-150 years ago which means that you would also have to consider a different climate period, land use etc.. I definitely would recommend to re-define the scope of the study, because in the current state, just distinguishing between 100% urban vs. 0% urban is not sufficient to analyze the above mentioned scenario.

I am further not fully convinced about the added benefit of this study for sustainable urban planning recommendations. I am aware that these model systems are not suitable

Printer-friendly version

Discussion paper

for applied urban planning, but however the currently existing urban canopy models in WRF-Chem (and other models), together with high resolution datasets for both emission and urban morphology do offer a framework for a number of different scenarios in the context of climate change/UHI mitigation. Recent studies have been analyzing the impact of highly reflecting building materials, urban greening or varying building density for a number urban areas. These aspects should also be possible with this model system and worth being discussed in order to increase the scientific substance of that work and highlight the new contribution to the field. In light of the scope of the journal, it should also be worked out more detailed what are the implications for atmospheric science in general rather than purely investigating local/regional aspects.

I am convinced, that the model system, combined with the emission and land surface data sets offer a promising tool for discussing air quality/meteorology interactions in large urban areas such as Los Angeles, but however think that the variety of scenarios should be increased in order to allow for a more robust results towards currently relevant issues. The authors rely mostly on previous work with equal model configuration. Therefore, the own contribution to the field and the new development does not come out clearly. The paper however is well written and easy to follow, but crucial points have to be considered in a review before being able undertake a detailed line-by-line evaluation.

1. The scope of the study should be defined more clearly in light of the above mentioned points. The experimental design should be expanded, in order to include more own ideas/developments.

2. One interesting and highly relevant point in my opinion is the 'irrigation' module which might offer a nice tool for testing different irrigation scenarios.

3. Why did you select a single-layer urban canopy model rather that a more complex multi-layer canopy representation (BEP/BEM)? The latter should deliver higher accuracy close to the ground I guess? What is the depth of the lowest model level?

4. Where do the input parameters for SLUCM come from?

5. What is the additional gain of a 30 m land surface classification which has to be scaled to 2 km model resolution?

6. Is there a problem with regard to the discrepancy between emission inventory and model resolution?

7. How realistic is the surrounding 'non-urban' land use classification for the 'historical' scenario?

8. How well does the model simulate urban AND rural parameters?

9. Please specify how results from this study can serve as contribution for applied urban planning?

10. In relation to other chapters, the introduction is slightly too long. Try to focus on the relevant points here and shorten were possible.

Please find below comments for specific sections, which partly have been addressed in the main points above.

Ln 11: ventilation not a good expression here

13: 'before human settlement' is a bit misleading here, as it is not entirely captured by your model setup. As mentioned before, some effort has to be put in a clear definition of the scope of your study. What problem should be addressed – also in light of recommendations for real urban planning (Lines 570-573?

43: "Differences in surface temperature..." What was the purpose of these studies mentioned here and what do they try to answer? How does this sentence relate to your study and the intention for this work?

47: "UCI": How does this relate to your study?

67: What is the role of the atmospheric aerosol burden for UHI formation?

73: better "characteristics/shape of the PBL is dependent on..."

81: better "due to urbanization..."

86: unclear what is meant by "meteorological changes via altered emissions,..."

115: Why do higher PBLs increase PM 2.5 concentration? Please discuss the related processes here.

119: How exactly does your experimental setup treat the "wide heterogeneity of urban land surface processes" compared to existing studies? A large number of studies already exist using model systems (e.g. WRF) which include urban canopy models with varying complexity (SLUCM, BEP), which consider a similar level of heterogeneity than your experiments? Please discuss your statement.

122: unclear expression "amongst"?

134-140: It should be made clear which new aspects you aim to analyze compared to the studies mentioned above. In my opinion simply turning urban on/off does not reveal significantly new insights. Further the term "human disturbance" is unclear, as this would also involve air quality modifications.

174: Please specify your lowest model level.

175: "process parametrization" unclear

180: please discuss the term "real world representation", answering the question why the WRF default land use classification in WRF is not "real" enough for your case comparing these datasets with your input. What was the idea behind using a 30m dataset? Please briefly discuss the gain of using 30 m land cover data for a maximum resolution of 2 km. How much information "is lost" by the process of "upscaling" the LU data. Would the 2011 NLCD dataset add additional benefit?

205: did you use the additional sub-tiling option in WRF?

243: Do you consider daily emission profiles? Meaning, do you find two "peaks" in for instance in NOx emission/concentration?

267: How realistic is the conversion to shrub-land for all grid cells? Would you expect different effects for a non-urban, but more heterogeneous "before human" land cover?

294: Please indicate better proof of the "good fit" mentioned here. It is not indicated by Figures S1 and 3 for pm2.5. How does the correlation coefficient look like? What are the reasons for the poor correlation especially for the high range of the observed concentrations? How representative are the measurement stations? As the ozone concentration is highly dependent on temperature you find a good fit. Does the poor fit for PM 2.5 relate to high mixing, chemistry, both? How do correlations look like for NO2,NO,CO? Are the simulated diurnal variations realistic? Please also discuss the values from Table 1? Are they particularly good/bad?

347: can you find impacts on the strength of the sea breeze when there is no urban area left?

363: what is the order of difference between shadow model on/off?

367: origin of the UCM parameters?

381: calculation of the ventilation coefficient?

386: please evaluate the quantity values here? Provide relative numbers

395: What is the relation between PBL height and surface roughness? Please provide more details. Can you find proof for this in your study?

490: can you say something about the change of PBL dynamic comparing urban and non-urban. I suspect concentration of PM 2.5 is highly dependent on the boundary layer depth. Expecting lower PBLs in "urban-free" areas actually should decrease PM 2.5 in summer?

530: What happens to the pbl height in non-urban environment? Even deeper?

535: specify "enhanced"

541: how confident are you that the land use class in the "before-human" settlement is correct? Or is it just a guess?

573: As mentioned earlier I am not entirely convinced, how findings from this study could be used for applied urban planning? You mention 'mitigation and adaptation', but a complete 'removal' of the urban area should be hard to transfer into an actual applicable strategies. Maybe more 'moderate' scenarios would be better. However, avoiding a complete re-doing of model experiments, the scope of the study should be formulated differently.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-889, 2018.