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Atmospheric Chemistry and Physics Discussions

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

Anonymous Referee #1

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The manuscript presents two sets of simulations realized with the model WRF-CHEM coupled with the Single Layer Urban Canopy Model, over the Los Angeles region for a 10 days period at the end of June-beginning of July 2012. One set of simulations is realized with the current landuse, including the urban area of Los Angeles. The second set is realized replacing the urban area with shrub, representing the original vegetation (as claimed by the authors). The anthropogenic emissions are the same for both simulations. By comparing the results of the two simulations, authors derive the impact of urbanization on meteorology and air quality in the region.

I have two main comments to this manuscript.

a) Authors rely heavily on previous work by the same team (mainly by Vahmani) to justify the set-up used, and the improvements obtained in simulating air temperature (for

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Discussion paper

example due to the inclusion of the irrigation system). However, at lines 358-361, they say that all the previous simulations were performed without accounting for the shadowing effect in the street canyon, and with a different technique to estimate the surface temperature. On the contrary, the simulations presented in the manuscript consider shadowing and use the default formulation to estimate the surface temperature for impervious surfaces. The impact on the results of these different modeling choices seems important to the point that with the new approach urbanization decreases daytime temperature compared to the non-urban case, while with the previous set-up urbanization increased the daytime temperature. While I certainly agree that it is important to account for shadowing, I think that it is necessary to perform a more thorough validation of the simulations to get more confidence in the results, also because the RMSE, presented in table 1, is much larger than the urbanization effect. Therefore, I recommend making a separate analysis of urban and rural stations, and to separate between urban stations based on the different urban morphological characteristics. The validity of this study relies completely on the model capability to reproduce correctly the differences between urban and rural areas, so it is very important to show this comparison. For example, the following questions should be addressed: what are the RMSE and Mean Bias for the urban stations only? And for the rural stations? We have to be sure that the model is simulating correctly the urban areas AND the rural areas (in particular shrubs). Is the model able to capture the maximum and minimum temperature at each station? Is the model able to reproduce the differences between stations, and in particular the differences between the urban and the rural stations? (e. g. if at a certain hour higher temperature is measured in an urban station compared to a rural one, is the model doing the same? If rural stations measured lower minimum (maximum) than urban stations, is the model doing the same qualitatively and quantitatively?, etc.).

b) It must be made clear that the simulation with current anthropogenic emissions, but not the city, is a hypothetical one – there cannot be emissions without a city. In the last sentence of the manuscript (lines 570-574), authors say that their results “can be informative for decision making on sustainable urban planning to achieve a balance

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between climate mitigation/adaptation and air quality improvements". Honestly, I do not see how. This type of studies may have a scientific value, in the sense that they demonstrate the importance of taking into account the presence of the city in the simulation of air quality and meteorology (it would be interesting to see if the simulation with the city provides better results compared to measurements than the simulation without the city). But I do not see how they can be helpful for urban planning. Replacing the city with shrubs cannot certainly be considered a strategy to manage urban climate or improve air quality. The differences that authors estimated between the urban and the no-urban simulations are not the maximum difference that can be obtained managing the landuse. They actually do not give any information about the impact of any realistic mitigation strategy based on landuse management. I think it is very important that authors clarify what they have in mind because this is at the basis of the motivation of the whole manuscript.

Detailed comments:

1) Lines 64-66. Urban regions in semi-arid or arid surroundings have a weak (or non-existent) daytime UHI, but they have a very strong nocturnal UHI. I think authors missed the fundamental difference between daytime and nighttime UHI, (being the latter the most frequent).

2) Line 168. On which basis authors claim that the period chosen is representative of summer conditions in Southern California?

3) Line 174. Please provide the value of the depth of the lowest model level.

4) Line 215. Is the irrigation module implemented just for the pervious fraction of the urban cells, or also for the rural cells (to account for agricultural crops in the region)?

5) Line 302. I would avoid indicating the percentage for temperature. This would depend on the unit (if you use Celsius or Kelvin). I would just put degrees.

6) Line 303. On which basis authors claim that this is "acceptable".

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7) Section 3.2.3. I suggest studying the difference in sea breeze front progression between the two cases (urban and no-urban). This will give a better understanding of what is happening.

8) Lines 335-338. This is not clear. Before it is said that urbanization decreases temperatures and not increases.

9) Line 370. During night time atmosphere cools. The energy stored in the building during daytime (what authors call upward ground heat flux, I suppose) reduces the cooling. The higher PBL in the urban simulation will reduce the cooling too because the effect of the surface cooling is distributed in a greater depth than in the no-urban case. The two mechanisms (energy stored in buildings, and high PBL), both reduce cooling. They do not compete they go in the same direction.

10) Lines 375-376. Same as above, during the night there is not heating, there is cooling.

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