Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-1046-RC1, 2017

Atmospheric Chemistry and Physics
Discussions

Interactive comment on "A wedge strategy for mitigation of urban warming in future climate scenarios" *by* Lei Zhao et al.

Anonymous Referee #2

Received and published: 12 February 2017

Overall

In this study, Zhao et al., combined offline mathematical attribution, and online model simulations to compare the effectiveness of four urban heat island mitigation strategies, including cool roof, green roof, street vegetation, and reflective pavement. Their major finding was that cool roof (albedo ∼0.9) was the most effective way to reduce urban daytime temperature, although none of the strategy was able to substantially reduce nighttime temperature. Overall, this is a well-written, high-quality, scientifically significant paper. Below, I have several concerns about methodology and underlying model assumption and many specific comments that may improve the wording.

Major comments

First, this study conducted CESM offline simulations driven by climate outputs from

fully coupled CESM runs. The justification was that "urban land unit in CLM comprise only a small areal fraction of each grid cell, changes in urban temperature would lead to negligible changes in grid cell mean temperature". I think this is totally dependent on model resolution. Fine resolution CESM can run at about 25kmx30 km. In this case, big cities (like New York city) will almost equal to the size of the grid cell. The change of urban temperature will substantially affect mean air temperature for this particular grid cell, and also adjacent areas.

Secondly, model simulations covered 1972-2004 and 2071 to2100. I wondered how to restart the model for the 2071-2100 periods (restart from state variables in the end of 2004?). The state variables are not consistent between the two time segments. Maybe one can assume that the size of the city is fixed, that's probably the default configuration of CLM urban module. But, the vegetated land unit change dramatically from 2005 to 2070, because of for example CO_2 fertilization effect, fire, natural vegetated land conversion. In either case, we expect to see significant changes of vegetated land surface properties from 2005 to 2070.

Thirdly, for the street vegetation strategy. I agree that the two end member interpolation is a feasible idea, given that CLM does not mix sub grid land units (such as natural forest and city). But, there is an implicitly assumption for this approach. Street vegetation composition must be the same as surrounding vegetated land unit. In CLM each vegetated land unit is further divided into multiple plant functional types (PFT). Normally, it is a mix of forest and grassland. I wondered what is a typical forest/grass ratio in a real street vegetation setup? What's the difference of vegetation composition between the city and rural area. CLM has vegetation composition (17 PFT) for each grid cell. Will be great, if the author can show that they are consistent with a real street vegetation, at least for forest/grass ratio, since forest and grass are distinct in terms of albedo and roughness.

Finally, for some concepts, better to shortly define them at their first appearance, just in case casual readers might also be interested in this paper.

Specific comments

P1L11 compounded -> exacerbated

P1L12 high temperature problem -> heat stress problem

P1.L13 various urban heat mitigation strategies

P1L15 white oases, briefly define what is “white oases”

P1 L22 urban residents

P1.L22 urban heat island, briefly define what is “urban heat island”

P2L1 trials -> experiments

P1L3 at the scale of individual buildings. Specifically, ...

P2L9 financially challenging

P2L10 these methods on temperature reduction

P2L13 mitigation strategies

P2L15 high computational demand

P2L20 Looks like meso-scale weather forest model has been successfully applied to whole continental US, then the first sentence of this paragraph doesn’t make sense.

P2L28 GCMs can provide usefully knowledge to city planners about

P3L1 on offsetting

P3L27 15 natural plant functional types

P5L18 climate scenarios (including . . .. . .)

P6L5 the current version, remove

P6L25 what are QS, QAH

P7L21 compared eq. 6 with eq. 2, looks like the reflective pavement strategy only considered direct effect of albedo change on temperature. I wondered, why reflective pavement ignored the second term in eq. 2?

P8L14. Figure 2 contains three climate zones (dry, continental, temperate), three scenarios (current, RCP4.5, RCP8.5), two setup (default and cool roof strategy). 3x3x2=18 combinations. What about street vegetation strategy?

Figure 5. Street vegetation and reflective pavement are they compatible? I guess, they are partially exclusive? High fraction of street vegetation will partly overlap with the pavement?

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-1046, 2017.