

Interactive comment on “Modeling of the anthropogenic heat flux and its effect on air quality over the Yangtze River Delta region, China”

by M. Xie et al.

M. Xie et al.

minxie@nju.edu.cn

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The details of our changes in manuscript can be found in the supplement file "acp-2015-787-supplement.pdf".

General comments from Referee 4

In this manuscript, the spatial distribution of anthropogenic heat (AH) emission with seasonal and the diurnal variations is constructed over Yangtze River Delta. AH impact on meteorology and air quality were studied, especially focusing on horizontal and vertical circulations. The effect of Urban Heat Island (UHI) by urban land-use on ozone

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and air quality have been reported in the world. However, limited data and simulations of UHI by AH on ozone and air quality are currently conducted. Such kinds of study, especially the seasonal differences of AH effects as presented in this manuscript, should be valuable and encouraged. The manuscript is well written and organized. The scientific issue raised in the manuscript that AH effects on meteo and O₃, NO_x and PM are interesting to the ACP audiences. I suggest publication the manuscript after addressing the comments and suggestions below:

Author's response:

Thanks for the affirmative comments.

Specific comments from Referee 4:

1) Since the AH effects (dynamic and chemistry) are generally quite weaker than that of UHI by land-use, and the mechanisms of AH effect should be different from land-use effect especially under distinct meteorological and diffusion conditions. I suggest the authors give a quick review of the UHI effect by land-use on meteorology and air chemistry, which have recently published on JGR-atmos and Boundary Layer Meteorology. I find some of the conclusions are different from that in this manuscript, for example the impact on PBLH and ozone vertical variations. I suggest the author compare the AH and UHI by land-use effects and give a more general conclusion.

Author's response and changes in manuscript:

The AH effects are generally weaker than those of UHI induced by urban land-use. So, more researchers paid attention to the latter issue in previous studies. As suggested above, we briefly review the investigations about the effects of urban land-use on meteorology and air quality in the YRD region. Please see lines 86-92 in the revised manuscript. We also quote two more references that recently published on JGR and BLM, that is "(1) Kang, H. Q., Zhu, B., Zhu, T., Sun, J. L., and Ou, J. J.: Impact of Megacity Shanghai on the Urban Heat-Island Effects over the Downstream City Kunshan, Bound-Lay Meteorol, 152, 411-426, 10.1007/s10546-014-9927-1, 2014." and "(2) Zhu, B., Kang, H. Q., Zhu, T., Su, J. F., Hou, X. W., and Gao, J. H.: Impact of

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Shanghai urban land surface forcing on downstream city ozone chemistry, J Geophys Res-Atmos, 120, 4340-4351, 10.1002/2014JD022859, 2015.". We find that their conclusions are little different from ours in this paper, because the mechanisms of AH impacts are different from the effects of land-use. We compare the different results, and give some briefly discussion. Please see lines 636-643 in the revised manuscript.

2) Interpret the QF,B , QF,T, QF,M in equation 1.

Author's response and changes in manuscript:

QF,B, QF,T and QF,M represent the heat fluxes deriving from energy consumption in buildings, transportation sector and human metabolism, respectively. Please see lines 127-131 in the revised manuscript.

3) I did not find the references "Ryu et al., 2013; Yu et al., 2014" the manuscript raised on page 8 in line 18.

Author's response and changes in manuscript:

The detail information of these quoted references is added. In the reference list of revised manuscript, please see lines 801-802 for Ryu et al. (2013) and lines 826-827 for Yu et al. (2014).

4) on page 16, "On account that AH and its diurnal variation are only added to the sensible heat item, there are no significant differences between the simulation for latent heat flux (LH)". I suggest the authors should indicate latent heat release could be a non-neglectable parts of AH due to many AH processes related to water vapor releaseing.

Author's response and changes in manuscript:

Thanks for this constructive suggestion. Water vapor could be released when excess anthropogenic heat is emitted from human activities. Thus, AH releasing processes might have some effects on the latent heat fluxes at surface in the

cities. But in our simulation and many other similar researches, the water vapor releasing was usually not taken into account. It is an interesting issue but a little different from the main purpose of this paper. We point it out in lines 433-435 in the revised manuscript as suggested above, and also want to do further study in the future.

5)On page 17, 2m-temperature changes typical value of 1.6 C in January and 1.4 C in July in Shanghai, and AH fluxes make the PBLH rise up to over 140m in January and more than 160m in july in shanghai. Please explain the reasons why surface temperature and PBLH changes are opposite in the two seasons.

Author's response and changes in manuscript:

The AH fluxes increase the 2-m air temperature (T2) in both months by adding more surface sensible heat into the atmosphere. Because the AH emissions are higher in winter (Sailor and lu, 2004; Flanner 2009), the T2 increment of 1.6 C in January is higher than that in July (1.4 C). But in summer, the weather is more unstable and the vertical convection is easy to form. So the adding AH might induce more increase of PBLH in July. So the change of PBLH is only 140m in January, while it is 160m in July. To put it another way, if we see the relative increases of PBLH caused by adding AH, 0.375 in January is still higher than 0.309 in July. On lines 470-471 of the revised manuscript, we add some brief explanation.

6)On page 22 line 22-25, I suggest you compare ozone variations in vertical with that on the references which ozone variations induce by urban land-use.

Author's response and changes in manuscript:

We compare vertical ozone variations caused by AH with those induced by urban land-use from previous investigations (Liao et al., 2015; Zhu et al., 2015) as suggested above. Please see lines 636-643 in the revised manuscript.

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Please also note the supplement to this comment:

<http://www.atmos-chem-phys-discuss.net/15/C13492/2016/acpd-15-C13492-2016-supplement.pdf>

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