Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-544-AC2, 2016


Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Changes of regional meteorology induced by anthropogenic heat and their impacts on air quality in South China" *by* Min Xie et al.

**Min Xie et al.**

minxie@nju.edu.cn

Received and published: 28 October 2016

The article analyses the impacts of anthropogenic heat (AH) emissions on the atmospheric conditions and air quality in South China considering January and July from 2014. The article is based in a spatial and temporal analysis of AH emissions from top-down energy inventory method and WRF/CHEM model simulations. This paper is very well written, organized, with very clear graphics/figures and with interesting analysis results. Despite of the positive view of the article, there are some deficiencies, but this referee recommends the manuscript to be accepted for publication in the Atmospheric Chemistry and Physics after suggested revisions are made. The suggestions are described below:



Printer-friendly version

Discussion paper

Thanks for the constructive and the affirmative comments.

Page 3, lines 84-86. The article showed that the main impacts of AH emissions were observed in Pearl River Delta (PRD) region. However, it is not presented an explanation of that region, such as which cities are located in that area. Please, for readers who do not know that area, provide more detailed information of the area, such as a map illustrating the location. In the same way, the article has a deficiency in the description of the South China region. This referee thinks that is important to describe some information about land use, land cover, topography, as well as the typical climatological and atmospheric conditions such as circulations breezes, among others.

Thanks for the constructive comment. To provide more detailed information of South China and PRD, Fig. 1b (with the green square to show the location of PRD) and some words (to briefly describe the information of topography, land use, climate, and atmospheric conditions, etc.) are added in the new revised manuscript. Please see lines 79-93 (brief description) and lines 212 -217 (Fig. 1b) in the revised manuscript.

Page 5, Figure 1 - The resolution of Figure 1 is not good. If possible, the authors could improve the figure.

Thanks for the constructive comment. Fig. 1 is replaced by a new high quality figure, with the improved resolution of 600 dpi. Please see lines 212-217 in the new revised manuscript.

Page 5, lines 176 - 178. In the description of chosen period, that is, January and July from 2014, the paper mentioned that “January and July are used to represent the hot and the cold weather condition, respectively”, but the months of January and July represent the cold and hot months for the region analyzed, respectively. Also in this context, why did you choose those periods? Moreover, the use of monthly average

could produce erroneous or masked results, since it includes days with different synoptic conditions.

Sorry for the clerical mistake "January and July are used to represent the hot and the cold weather condition, respectively". These words are changed to "In South China, January is generally representative of the relatively cold and dry season, while July represents the relatively hot and wet weather condition" in the new revised manuscript. Please see lines 183-186.

In the paper for studying the influence of urban expansion on O3 distribution over the PRD region (Wang X. M. et al., 2014), it is reported that "Representations of seasonal results are created using hourly URB results from January and July. The two months are representative of the relatively cold and dry season of the year, and the relatively hot and wet season of the year, respectively. ". So, we choose January and July of 2014 for our simulations. To better clarify our consideration, we rewrite the relevant sentences and cite the paper by Wang et al. (2014) in the new revised manuscript. Please see lines 183-186 and lines 867-869.

In previous studies, Ryu et al. (2013) studied the effects of AH based on an episode, while Yu et al. (2014) investigated this issue by using the monthly average (August) as well. We agree that "the use of monthly average could produce erroneous or masked results, since it includes days with different synoptic conditions.". But the main purpose of this paper is not to discuss the effect of AH on a pollution episode. We want to know the relative longtime effect of AH, its tendency, and the seasonal difference. In this case, it is a common method to use the monthly mean values to discuss the effect (Wang et al., 2014; Yu et al., 2014; Liao et al., 2015; Xie et al., 2016).

Page 6, lines 182-183. The authors present a vertical cross section analysis through the line AB reaching the Haikou and Guangzhou areas. However, it is not presented the motivation of choosing that line. If line AB was a latitudinal section, approximately

22.5âŰęN or 23âŰęN reaching the Nanning and Guangzhou areas, do you think it would be possible to find a different pattern from the impact of AH emissions? Why?
The vertical cross section analysis through the line AB is to discuss the different effects of AH on ambient environment between the big (Guangzhou) and the relatively small (Haikou) city. To better present the motivation of choosing this line, we add these words for explanation on lines 380-381 of the new revised manuscript.

We choose Haikou as the representative of relatively small cities because there are no other cities between Guangzhou and Haikou along line AB.

The AH emission in Haikou is close to that in Nanning. So, we believe that the vertical changing pattern from the impact of AH should be similar if line AB reaches Nanning and Guangzhou. We also do the vertical cross section analysis through the line reaching the Guangzhou and Nanning areas. The results are similar. For example, the figures to illustrate the vertical changes of O3 impacted by adding AH (Grd-AH minus Non-AH) are similar to Fig. 9c and d.

Page 6, lines 186-193. In the description of the physical parameterizations schemes, it was mentioned about which urban canopy parameters were adopted. Then, it would be interesting to add a descriptive table that contains main urban parameters such as height of buildings and constructions, street and avenues information, albedo of urban areas, among others.
Thanks for the constructive comments. We add the descriptive table (Table 2) that contains the modified values of main urban parameters. Please see line 221 of the new revised manuscript. Additionally, we also add some explanation words for the table on lines 190-193.

Page 8, line 266. The mentioned figure seems to be wrong (Fig.4f). It would not be

Fig.2f?
Sorry for this clerical mistake. The figure number "4f" on line 266 of the original manuscript is replaced by "2f". Please see line 279 of the new revised manuscript.

Page 12, line 358-360. The article demonstrates the impact of AH emissions on the atmospheric condition through the analysis of some variables such as wind speed at 10m (WS10) and vertical wind velocity (w). Do you think that AH emissions can disturb the horizontal wind regime? How AH emissions can affect the land and the sea breezes circulation? The spatial and temporal patterns of these variables and their correlations would be investigated more properly.
We agree that AH emissions may affect the land and the sea breeze circulation. We also think that it is a good idea to study the influence of AH on these local breezes. We add "It is worth mentioning that the changes of vertical air movement and surface wind may affect the local land-sea breeze circulation in the coastal cities. For example, AH emission in Haikou enhances the upward air movement above the city (Fig. 6c and d), causes the downward movement above the surrounding waters (Fig. 6c and d), and increases the surface wind from sea to land (stronger convergence). These changes imply that AH might strengthen sea breeze in the daytime and weaken land breeze at night." in Section 3.3.2. We also add Fig. 7e and f to discuss the temporal pattern of the effect of AH on WS10, and find that "For WS10, AH emission causes it to increase 0.07 m/s in January and 0.15m/s in July. Most increases occur in the daytime. The effect of AH on surface wind is negligible at night, which may be related to the fact that the land breeze at night (from land to sea) hinders the surface convergence (from sea to land) caused by AH. ". Please see lines 458-463 and 520-524 in the new revised manuscript.

To perfectly discuss this issue, we should focus on a smaller region and use high-resolution simulations, which we plan to do in the future.

Page 13, line 381-382. The other deficiency is the description that AH emissions can modify the Urban Heat Islands (UHI). It appears to be questionable whether the increase in AH emissions can quantitatively enhance the UHI. The authors could provide concrete evidence of the UHI intensification. One way that authors can analyze could be the temperature difference between the most urbanized region (e.g. Guangzhou) and rural or less urbanized region (e.g. Nanning or Haikou) for simulations with (Grd$_AH$)$and without adding AH (Non_AH). Therefore, perform an analysis of the Urban Heat Island Intensity (or UHII) and$
$Thanks for the constructive comments. We perform an analysis of the Urban Heat Island Intensity, and find that AH emission$

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-544, 2016.



Printer-friendly version

Discussion paper