January 14, 2017

Dear Dr. David Parrish,

We have received your comments of the manuscript. Below are our responses and the revisions that we have made in the manuscript.

Thank you for your efforts on this manuscript. We look forward to hearing from you.

Best Regards,

Guohui Li

Reply to the Editor, Dr. David Parrish

We thank the Editor, Dr. David Parrish for the careful reading of the manuscript and helpful comments. We have revised the manuscript following the suggestion, as described below.

In my judgment the paper is suitable for publication when some further minor revisions are made.

I. In accord with Review #1, I think that some of the discussion is overly speculative, and thus does not add to the paper. Generally, removal of some material, rather than additional discussion is required. Specific suggestions follow.

Comment: Lines 422-424: I suggest eliminating the last sentence. It may well be correct, but that correctness is not demonstrated in this paper, so it can simply be removed.

Response: We have eliminated the sentence in the manuscript in Section 3.2.2.

Comment: Lines 477-479: I suggest eliminating the phrase in yellow, i.e., ", which is due to the increased atmospheric oxidation capability caused by elevated O_3 concentrations during summertime." I do not believe that it is well established that elevated O_3 concentrations cause high SOA. Rather I think that both high O_3 and high SOA are products of the oxidation processes.

Response: We have deleted the sentence in the manuscript.

Comment: Line 505: Should be: "... condensable gases do not change, more organic condensable gases partition into the ..."

Response: We have changed the word "*participate*" in the manuscript as "*partition*".

Comment: Line 514: eliminate " deliberate"

Response: We have eliminated the word "*deliberate*".

Comment: Lines 515-528: These sentences give plausible explanations for the interactions determined from the analysis, but the explanations are speculative. These

sentences should be greatly shortened, limited to reporting the magnitude of the emission interactions.

Response: We have revised the sentence in Section 3.2.4 as follows: "*The nitrate contributions from emission interactions are 18.1%, much more than those for other aerosol constituent. The sulfate contribution from emission interactions is not significant, only 3.4%. The ammonium contributions from emissions interactions are 1.5%, similar to those of primary aerosol species.*"

Comment: Lines 562-575: This discussion is also largely speculative, and in some instances, may not be correct. For example, Mexico City does have substantial industrial emissions. It may be useful to point out that a comprehensive model comparison of summertime pollution in Mexico City and Beijing could be illuminating, but the present discussion is too speculative; please shorten.

Response: We have classified the discussion as follows: "*However, it is still controversial on whether local or non-local emissions play a dominant role in the air quality in Beijing (Guo et al., 2010, 2014; Li et al., 2015; Zhang et al., 2015). When only considering the local emissions, the summertime $PM_{2.5}$ level in Beijing is comparable to that in Mexico City. Mexico City has once been one of the most polluted cities in the world, but the air quality has been greatly improved in recent years after taking emission control strategies (Molina et al., 2002, 2007, 2010). Therefore, a comprehensive model comparison of summertime pollution in Mexico City and Beijing would be illuminating for elucidation of the contributions of trans-boundary transport to the air quality in Beijing.*"

Comment: Lines 576-589: This material has been added in response to a Reviewer's comment, but I do not think that it is well done. It would be improved if shortened to something like: "This study mainly aims at providing a quantification of the effect of trans-boundary transport on the air quality in Beijing. It demonstrates that the effective approach to improve air quality in Beijing is to reduce both local and non-Beijing emissions in BTH. Further sensitivity simulations of different emission reduction measures are needed to design the most efficient emission control strategies."

Further, even this paragraph is somewhat duplicative of the final paragraph, so the best approach is to combine the final two paragraphs of the revised manuscript into a single paragraph that concisely and clearly combines the short paragraph suggested above with the paragraph on lines 590-600.

Response: We have revised the paragraph in conclusion as follows: "*It is worth noting that, although the WRF-CHEM model well captures the spatial distributions and temporal variations of pollutants, the model biases still exist. The discrepancies between the predictions and observations are possibly caused by the uncertainties in the emission inventory and the meteorological fields simulations (Zhang et al., 2015). BTH has been considered as a polluted air basin (Zhao et al., 2009; Parrish et al., 2015), which frequently experience O_3 and $PM_{2.5}$ pollutions during summertime. Future studies need to be conducted to improve the WRF-CHEM model simulations, and further to assess the contributions of trans-boundary transport of emissions outside of Beijing to the air quality in Beijing, considering the rapid changes in anthropogenic emissions since implementation of the APPCAP. This study mainly aims at providing a quantification of the effect of trans-boundary transport on the air quality in Beijing. It demonstrates that the effective approach to improve air quality in Beijing is to reduce both local and non-Beijing emissions in BTH. Further sensitivity simulations of different emission reduction measures are needed to design the most efficient emission control strategies.*"

II. In general I think that the English usage in this paper is quite good. However, in many places there is confusion of present and past tenses and singular and plural. Some examples from the Introduction and the Summary and Conclusions Sections, with suggested changes indicated in yellow are given below. I suggest that the paper be edited throughout for consistent use of these issues.

Comment: Line 53: " summertime O_3 mass concentrations reached high levels in 2014 in Beijing,"

Response: We have revised it in the manuscript.

Comment: Line 55: " maximum daily O_3 concentrations were higher than 150 μg m^{-3} during the summer in 2015"

Response: We have revised it in the manuscript.

Comment: Line 60: " daytime average O_3 concentration still increased rapidly (Tang et al., 2009;"

Response: We have revised it in the manuscript.

Comment: Line 74: " the transport from the environs of Beijing contributed about 55%"

Response: We have revised it in the manuscript.

Comment: Line 77: " (hereafter referred to as APPCAP) has been implemented, which was released"

Response: We have revised it in the manuscript.

Comment: Line 532: " and $PM_{2.5}$ is simulated using ..."

Response: We have revised it in the manuscript.

Comment: Line 535: " concentration in the afternoon has increased by ..." (been eliminated)

Response: We have eliminated "*been*" in the conclusion.

Comment: Line 536: " and Beijing still has experienced high O_3 and/or $PM_{2.5}$ concentrations frequently during"

Response： We have changed the word "*pollutions*" as "*concentrations*" in the conclusion.

Comment: Line 547: " included in model simulations, the O_3 and $PM_{2.5}$ concentrations in Beijing still remain high"

Response: We have changed the word "*considered*" as "*included*" in the manuscript.

Comment: Line 548: Eliminate " levels"

Response: We have eliminated "*levels*" in the conclusion.