Dear referee #1,

We thank you for your time on our paper. The comments and suggestions are useful to improve the quality of the manuscript. Herein we present the replies to all the comments on our manuscript named "Effects of black carbon and boundary layer interaction on surface ozone in Nanjing, China"

(1) The address for 5th institution should be 'Tropical and Marine Meteorology'.

Reply: Follow the referee's comment. We have rechecked the address of the 5th institution and corrected it in the revised manuscript.

(2) The conclusions in abstract are a little messy, please reorganize your findings.

Reply: Thank you for your comment. Our main conclusion of our study is that, with the impacts of BC, the surface ozone reduced before noon which is primarily caused by the changes in the ozone contribution from chemical and physical processes. Among the changes in these processes, the change in vertical mixing process takes major responsibility for the reduction of surface ozone. We have adjusted the conclusions in abstract. And we believe that the conclusion will be more clear and easy to following. Please check the new abstract in the revised manuscript.

(3) Page 9 line 17: Please define how you calculate the ozone gradient.

Reply: Follow this comment. The vertical gradient of ozone is the difference of the ozone concentration between every two adjacent vertical layers. Because of the sigma coordinate in vertical direction in WRF-Chem, the ozone concentration is firstly interpolated in vertical direction with height interval of 50m. And then, the vertical gradient of ozone concentration is calculated as the Equation:

$$vertical\ gradient = O_3(h_{i+1}) - O_3(h_i) \quad (i = 1, 2, 3 \ldots\ldots)$$

where h_i and $h_{i+1}$are the heights of layer i and $(i+1)$. The h_{i+1}equals to $h_i + 50$. $O_3(h_i)$ is the ozone concentration at the height of h_i. The definition of ozone gradient and the equation have been added into the revised manuscript. Please check them in page 9 (lines from 31 to 34) and page10 (lines from 1 to 3).

(4) Page 10: the less ozone near the surface is very likely caused by less ozone production aloft (Figure 6d), not weakened turbulence. Please provide a more comprehensive explanation for this.

Reply: Thank you for your comment. The less ozone chemical production aloft will influence the surface ozone. For example, the reduction of chemical contribution will change the ozone vertical gradients which could influence the vertical mixing of ozone which occurs in the BL and finally reduce the surface ozone. However, according to our results, the CHEM_DIF aloft occurred one hour later than the reduction of surface ozone did. In addition, the value of CHEM_DIF was small whereas the value of VMIX_DIF in the BL was large (-18 - -8 ppb h^{-1}) which suggested that the less chemical production aloft impacted limitedly on vertical mixing and surface ozone. Besides ozone gradients, VMIX is closely related to the turbulence. As Figure 7b shows, the turbulence exchange coefficient with the impacts of BC was much smaller than that without the impacts of BC. It suggested that, when ozone gradients in the two cases were similar with each other in the morning, the much weaker turbulence would entrain much less ozone down to surface and made the ozone reduction. Thus, it could be concluded that the reduction of surface ozone was primarily caused by the weakened turbulence. We have added more detailed discussion of this section and please check the details in pages from 8 to10 in the revised manuscript.

(5) Please be careful when interpret the surface VMIX term, because it also includes information of chemical production above surface. For example, if chemical production above surface larger and higher ozone above surface, it will lead to a positive VMIX term at the surface.

Reply: Thanks, we agree with your comment. The contribution from VMIX at surface is related to the turbulence and ozone vertical gradient above surface. Chemical production above surface will influence ozone vertical gradient. Thus, ozone exchanging in vertical direction, the VMIX at surface is surly includes the

information of chemical production above surface. In our study, we primarily talked about the changes in processes contributions caused by BC. In figure 6d, with the impacts of BC, chemical contribution aloft decreased (with decreased rate between -9.4 and -2.1 ppb h^{-1}) from 11:00 to 14:00. This reduction would change the vertical gradients of ozone and further influence the vertical mixing of ozone. However, the significant change in vertical mixing in the BL (-18 to -8 pph h^{-1}) suggested that the changes in chemical process cause limited influence on the changes in vertical mixing process. According to our discussion, the weakened turbulence and the suppressed BL, which being caused by the impacts of BC, were more important to the change of VMIX.