Response to Reviewer 1

Sun et al. present a long-term analysis of ozone at Mt. Tai mountain station over the North China Plain in China during 2003-2015. This study focuses on the variation and trend of summertime ozone, and points out that the increased VOC emissions other than changes in meteorology or NOx emissions are responsible for the elevated summertime ozone at the monitoring site. The manuscript is well structured, the methodology is appropriate and properly conducted, and the conclusion drawn is fully supported by the data presented. It is recommended that this manuscript be accepted after consideration of the few minor comments that follow.

Response: we appreciate the reviewer for the positive comments and helpful suggestions. We have revised the manuscript accordingly and here address individually the review comments. For clarity, the reviewer's comments are listed below in black italics, while our responses and changes in manuscript are shown in blue and red, respectively.

 P2L10, I don't see any relevance of this sentence to the study. And why the observations at Mt. Tai are 'ideal' for evaluating CTMs?

Response: this sentence has been removed from the revised manuscript.

2. P2L23, 'the changing tropospheric O_3 ' is confusing. Suggest using 'the changes in tropospheric O_3 '.

Response: changed.

3. P4L16, suggest replacing 'at the site' with 'at this site'.

Response: changed.

4. P4L19-20, suggest replacing ';' with '.' and capitalizing the following word.

Response: changed.

5. P8L2, what does 'the latter' refer to, 'less O_3 loss' or 'long-range transport of processed regional plumes'? Also, NO_2^* peaks around 20:00 p.m. but NO reaches the lowest level around 6:00 a.m., isn't it?

Response: 'the latter' refers to the long-range transport of processed regional plumes. The

higher NO_2^* levels suggest the transport of anthropogenic pollution to the mountain site (note that the NO_2^* includes not only NO_2 but also some higher oxidized NO_Z species), and the relatively low NO concentrations (it doesn't matter if NO was at its lowest) indicate that the air masses had been chemically processed (or aged). In the revised manuscript, the original statement has been revised as follows to clarify this issue.

"The transport of reginal plume was evidenced by the coincident evening NO_2^* (including NO_2 and some higher oxidized nitrogen compounds) maximums and relatively low NO levels (indicative of the aged air mass), as shown in Fig. 4."

6. P9L10, according to the frequency, no air mass transported from the south in June and more is from the north than the south.

Response: from the back trajectories, both "M&EC" and "CC" air masses originated from the southeast and south. These two types of air masses accounted for 83% of the total in June. Thus it could be said that the air mass transport was dominated by the southerly and easterly air flows. We have elaborated this by the following statements in the revised manuscript.

"Marine and East China" (M&EC) – air masses from the <u>southeast</u> passing over the ocean and polluted central eastern China;

"Overall, the transport patterns in June and July–August are quite similar, and it is evident that southerly and easterly air flows (e.g., M&EC and CC) dominated the air mass transport to Mt. Tai in summer."

7. P9L19, again, why does the southern part of central eastern China greatly impact ozone at *Mt. Tai?*

Response: this argument is supported by the analyses of frequency and chemical composition of air mass types. Specifically, the "M&EC", "CC" and "NEC" air masses occurred the most frequently. These air masses had passed over the southern and eastern parts of central eastern China prior to arriving at Mt. Tai, and contained relatively higher concentrations of O_3 and O_3 precursors. These results indicated that the southern and eastern parts of central eastern China significantly affect the ozone pollution at Mt. Tai. The original statement has been revised as follows.

"In view of the higher frequency and higher O_3 levels of the M&EC, CC and NEC air masses, it could be concluded that the regions with the greatest influence on O_3 at Mt. Tai in summer are primarily located in the southern and eastern parts of central eastern China."

8. Have you looked at the contribution of stratosphere to troposphere transport to the surface ozone at Mt. Tai?

Response: the stratosphere to troposphere exchange (STE) generally occurs at its maximum in spring. In summer, the O_3 pollution levels at Mt. Tai should be primarily affected by the photochemical processes of anthropogenic pollution in the planetary boundary layer (Li et al., 2008). As the present study mainly focused on the summertime O_3 trend, we didn't consider the contribution of the STE process.

Li, J., Wang, Z., Akimoto, H., Yamaji, K., Takigawa, M., Pochanart, P., Liu, Y., Tanimoto, H., and Kanaya, Y. Near-ground ozone source attributions and outflow in central eastern China during MTX2006. *Atmos. Chem. Phys.* **8**, 7335-7351, 2008.

9. Note a in Table 3 needs to be reformatted.

Response: done.