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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Overview of the Mount Tai Experiment (MTX2006) in Central East China in June 2006: studies of significant regional air pollution" *by* Y. Kanaya et al.

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We thank the reviewer very much for reading our paper carefully and giving us valuable comments. Detailed responses to the comments are given below.

Comment 1: It was indicated that the general objective of MTX2006 was to quantify the air quality in the region. However, according to the aims listed in Sec 2 and the published papers of MTX2006, it is very much an atmospheric chemistry experiment with focus at ozone and aerosols. Thus, as an overview paper, the readers would expect to see a synthesis discussion upon the air quality implications of the great scientific

findings.

Answer: By "air quality" we generally meant status of concentrations of primary and secondary air pollutants in the previous manuscript. To avoid confusion, the term "air quality" was replaced by specific terms, for example, concentrations of O3, aerosols (including BC), and their precursors, for the case in section 2, except for the cases where we just meant the concept of air quality.

Comment 2: The boundary layer dynamics is among the major mechanisms controlling the diurnal variations of the measurements of gaseous and aerosol species. Do you have a paper discussing the influences of boundary layer and/or general meteorological conditions during MTX2006? If not, I'd like to suggest giving a summary in this overview paper.

Answer: There is no companion paper treating the behavior of boundary layer dynamics. In Figure 2, we will newly include a time series plot of the mixed layer height from GDAS1 data (Air Resources Laboratory, NOAA), and mention that the observational site was typically within the planetary boundary layer during daytime and within the residual layer during nighttime. We will retain the meteorological data and summary explanation as presented in the previous manuscript, including low-pressure system passage, wind direction, precipitation, J values, temperature and humidity.

Comment 3: (P1538) It was indicated that "In conclusion, the air quality at the top of Mt Tai is comparable to that in the outflow region or even the urban Beijing". However, the above "conclusion" was drawn merely from the measurements of OC and EC in aerosols. I suggest making the conclusion specifically on the levels of carbonaceous aerosols (i.e. OC and EC) instead of generally on "air quality".

Answer: This sentence was a summary based on discussion in the preceding several paragraphs regarding O3, CO, and aerosols (including OC and EC). To make this point clearer, in the revised manuscript, we will start a new paragraph here and mention that "in conclusion, O3 and aerosol concentration levels at the top of Mt. Tai are compa-

rable to those in the outflow region or even the central urban area of Beijing, although photochemical age must be different".

Comment 4. (P1539 and Fig 6) It was observed that "BC showed high concentrations in early morning". What were the potential sources of the early morning BC (without substantial increases in CO)?

Answer: We identified the cause of the early morning peaks during revision and will mention as follows: The peak of BC in the early morning (04:00âĂŠ06:00 LT) was influenced by very high concentrations occurred in these hours on 7 and 13 June, which are ascribed to OCRB. After 16 June, O3, CO, NOy, and BC commonly showed diurnal patterns with single afternoon peaks. As suggested by Reviewer #2, average diurnal variations of O3, CO, NOy, and BC during non BB periods will be added to Fig. 6.

Comment 5. (P1539) I cannot follow the calculation of aerosol radiative forcing. How did you obtain the value of 55W/m2 for aerosol RF? Besides, please note that the DRF efficiency given in IPCC (2007) is associated with substantial uncertainties.

Answer: At the proof reading we failed to find that a decimal point was missing; 5.5 W m-2 is correct. Our explanation will be improved in the revised manuscript as follows: First, we simply estimate its column concentration (5.2 mg $m-2$) by multiplying the monthly mean concentration (3.4 micro gC $m-3$) observed at the mountain top by the altitude (i.e., 1534 m), assuming a box-shaped vertical profile. Then, by multiplying a factor of 0.85, assuming that 85% of BC is anthropogenic (Bond et al., 2011), and a sensitivity factor (1.25 W $mg-1$, IPCC, 2007), we obtain an RF as high as 5.5 W $m-2$.

Comment 6. (P1541) The authors argued that the high O3 in June at Mt Tai was due to biomass burning. However, as indicated there, the average impacts of OCRB to O3 was only 6%. Thus, it seems that the conclusions did not get support from the results of data analysis.

Answer: The "6%" was an average over CEC. Relatively larger impact (9.3%) was present for our location as discussed in the previous manuscript. Here, our point was that the "sharp rise" in the monthly O3 concentrations in June (Fig. 5), whose cause had not been understood and thus not well simulated, was identified to be OCRB. We do not attribute large parts of 82 ppb of ozone to OCRB. To clarify this point, we will mention at the end of section 6.2 that the real cause of the sharp rise in the O3 concentrations in June at Mt Tai (Figure 5a), which had been a mystery, was therefore identified as biomass burning.

Comment 7. (P1542-1543) Regarding the attribution of O3, it was indicated in Sec 6.3 that "photochemistry in the surrounding region is more dominant than transport". However, in Sec 6.4, it was argued that "O3 transport is more important than in-situ photochemistry". Thus, the results from the two studies disagree with each other and could confuse the readers.

Answer: In section 6.3, we raised "vertical" transport as a possible cause of the "diurnal" variations, as opposed to section 6.4, where the relative importance of "horizontal" transport over in-situ photochemistry for accumulation of O3 to >100 ppb is mentioned. We will mention in section 6.3 of the revised manuscript that the photochemistry in the surrounding region accounted for most of the increases in O3 mixing ratios from morning to mid-afternoon and that the role of vertical transport was minor, and in section 6.4 that O3 transportation is more important than in-situ photochemistry for accumulation of O3 to > 100 ppbv.

Comment 8. (P1544 and Figure 4) OPEx of 5.8 was derived from the measurements of O3 and NOz and, as indicated the authors, is comparable to the OPEx around Beijing. However, Beijing is known as an urban area where O3 production is mostly limited by VOC, whereas Mt Tai case was suggested to be NOx-limited. Actually, in a NOx-limited case, the production of NOz should be retarded and thereby the OPEx is expected much higher the observed level. Please include further evidences to support the "NOx-limited" conclusion.

Answer: It should be noted that T. Wang et al. (2006) studied NOx-limited conditions in the rural part of Beijing (Changping) and obtained 3–6 ppbv ppbv-1. For our campaign, Kanaya et al. (2009) of this special issue studied O3 production regimes in depth, by performing sensitivity analyses (with altered NOx and hydrocarbon concentrations by 10%) and have concluded that O3 production is generally limited by NOx. Here we just cite this information. In the revised manuscript, we will clearly mention these points.

Comment 9. (P1545 and Figure 4) Higher OPEx given by model was indicated but did not get well explained. Comparing Figure 4c with 4f, I wonder if the model had underestimated the formation of NOz and therefore gave higher OPEx.

Answer: We agree with the referee's comment. We will mention that our analysis suggests either that the O3 production efficiency per unit NOx molecule oxidation is slightly lower than that predicted by the model or that the model underestimated formation of NOz.

Comment 10. (P1551) It was shown that peaks of organic aerosol tracers of biomass burning were observed in early morning. This is consistent with the early morning BC peak shown in Figure 6. I'd like to suggest incorporating the data of organic tracers and BC to investigate the transport of biomass burning BC in this region.

Answer: We will mention the similarity in the early morning peaks found in BC and the organic aerosol tracers. Upon suggestion, we decided to include time series of BC and selected biomass burning tracers (mostly organic tracers) in Fig. 9. Because organic tracers could be lost at least partially during transport, we did not include detailed estimation of the BC/tracer ratios or their transport analysis.

We thank the reviewer for their comments helping us to improve our manuscript.

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