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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Sensitivities of NO_x transformation and the effects on surface ozone and nitrate" *by* H. Lei and J. X. L. Wang

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We wish to express our appreciation to Reviewer 2 for the careful review, supportive comments, and detailed editing. Your very careful comments have effectively improved the quality of our draft. In the revised manuscript, we revised the manuscript based on your comments. In the response below, we address each of these comments. The Reviewer's comments are italicized and our responses immediately follow.

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#This manuscript analyzes observational data and model outputs to investigate the effects of temperature and NOx emissions on the concentration of surface ozone and nitrate aerosols. The authors showed how the changes in NOx emissions and tropo-

spheric temperature are related to surface ozone and nitrate aerosols in the United States.Unfortunately, the overall quality of this manuscript is poor. First, almost all data analyses here lack statistical robustness. Especially based on Fig 2 and Fig. 3, it is not convincing that we can trust the results from CAM-chem. The authors must provide a map of biases with conïňĄdence levels. The ozone bias of CAM-chem within the selected region in Fig 6. is large compared to the ozone change in Fig. 5. Statistical signiïňĄcance must be shown for the changes drawn in Fig.4, 5, 8 and 9. Fig. 7 and Fig. 10 needs to show error bars in each month. Also please calculate temporal trends in Fig. 11 and Fig. 12 and test their statistical signiïňĄcance. The left panel of Fig. 10 also requires rescaling of its y-axis. Second, there are a lot of hand-waving explanations. For example, the signiïňĄcant role of hydrocarbon is mentioned in Section 3.2, but the current version of manuscript does not include even a single map of hydrocarbon concentrations. Also in Section 3.3, the authors argue that the NOx concentration results from transport. Please show some supporting plots, tables or at least some numbers.

Revised: We agree with these comments. We further revise all figures based on these suggestions. Figure 2 and 3 are revised by adding maps of biases, and the confidence levels are also discussed in the text. We replaced the plotted nitrate aerosols by total nitrate in figure 4 and 8 based on reviewer 1's comments. We further discussed the confidence in the text. Following your suggestion, we added error bars for figure 7 and 10 in each month. Temporal trend for figure 11 and figure 12 are also analyzed. Hydrocarbon concentrations are further discussed in the text. We added plots to support the transport impacts on farming regions.

#Finally, the authors might want to highlight more what makes this study unique such as the results in Fig. 7 and 10. A lot of ïňĄndings in this study are not something new. It has been well known that VOC and NOX are related to surface ozone and nitrate aerosols.

Revised: Thanks for the comments. We follow your comments to add more detailed

ACPD
13, C9629–C9633, 2013

results from our analyses on this issue. I believe these will improve the interpretation of our study. Although we have known that VOC and NOX are related to surface ozone and nitrate aerosols, our further study on the sensitivity of NOx transformation will further enhance the understanding on these complex processes.

#Please cite some related studies and compare your results with them. I have seen too many citation of the papers written by Dr. Lei. Just as summarized above, I guess that most of the reviewers must reject this manuscript because of its quality, but I might perhaps save it if the authors improved the three points that I mentioned. So I admit keeping the review process, and my evaluation is asking major revisions, but I will reject the manuscript unless the authors satisïňĄed me in the next round of reviews.

Revised: We cited and compared more results from previous studies on related issues. We was planning to write a short article on this study. Now, it seems that it is better to include more detailed results in order to state a whole story. In this revision, we further enhanced our expression on the results and show more detailed analysis based on our experiments. We also discussed this article with Dr. Sasha Madronich and learnt a lot from his study on this issue. These have been included in the new manuscript.

SpeciïňĄc comments: # Although I am not a native English speaker, some English wordings seemed strange. For example, Line 23 in Page 21962: which? Caption of Fig. 1: I cannot understand this sentence. 'Axes indicate the powers that push the transformation change.'

Revised: Revised. The sentence was for a previous version of manuscript. We will further check the manuscript before submission.

Fig. 1: Where are Rhombuses? Please provide a version with higher resolution. # Fig. 2 and Fig 3.: (Left) and (Right) must be (Upper) and (Lower). Also please make your own plot using the CASTNET observations.

Revised: We revised the plots or by adopting bias map based on reviewer's comments.

ACPD
13, C9629–C9633, 2013

Page 21962Line11: 'The decrease or small increase in ozone: : :." Please rewrite this sentence. Line16: what is seasonal transfer? Is this a commonly used term?

Revised: We revised the expression to avoid misunderstanding.

Page 21963 Line 28: The entire study is about the changes of ozone and nitrate aerosols in the US. Why did the authors change the NOx emissions globally? Is there any reason for 25% of decrease and increase? Is '25%' related to any IPCC scenarios?

Revised: We modify it globally in order to keep the global change evenly. A typical sensitivity experiments require that we do both decrease and increase, which can avoid the sensitivity is on an extreme (turning) point. 25% is not related to any scenario and just a perturbation for sensitivity study.

Page 21964 Line 7: To examine 'air quality change', the authors should focus on 8-hour maximum ozone and total PM 2.5 increases.

Revised: It is correct that 8-hour maximum ozone and total PM 2.5 are more important for air quality discussion. We change the model evaluation figures by examining 8-hour maximum ozone. Since this study focuses on the sensitivity of NOx, other analyses are still focus on the detailed ozone or nitrate change.

Page 21965 Line 9: Rather than saying the perturbation is stable, I would suggest other words such as 'symmetric'. How can we measure stability by comparing two perturbation simulations with the control run? Line 15: What is emission analysis?

Revised: Good comments. We revised the words to better interpret the concept. A stable sensitivity study requires that the result is not taken on an extreme/turning point of a variable or a system. Decrease and increase perturbation show symmetric sensitivity just confirm this.

Page 21966 Line 6: Did this study use NCEP2 reanalysis data or CCSM3 meteorology? Line 16-18: I disagree with that the model can reproduce reasonable surface ozone.

ACPD

13, C9629–C9633, 2013

Revised: We use the NCEP reanalysis data for study. We revised the text and expressions to improve this part.

Page 21967 Line 13: the east? Does it mean east coast? Line 16-18, 22-26: This is an example of hand-waving explanations.# Page 21968 Line 8-10: The signiïňĄcance of changes must be measured based on statistical tests.# Page 21969Line 25-28: This is another example of hand-waving explanations.# Page 21970 Line 13-16: Please redraw Fig.10 with error bars.# Page 21971 Line 23-25: Please show some numbers and their statistical signiïňĄcance.

Revised: Thanks, we improved the expression and analysis.

Page 21972 Line 6-7: This is not something new from this study. Line 13-14: Please rewrite the sentence. Does this mean that Atlanta is in NOx-limited regime only in winter? Line 21-24: Please mention that this study focused on only the contiguous United States.

Revised: Previous studies have shown that Atlanta is in NOx-limited regime all year around. This is just to support our conclusion and explanation in the end.

Page 21973 Line 9-12: Please rewrite this sentence.

Revised: thanks, revised.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 21961, 2013.