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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Observation and modeling of the evolution of Texas power plant plumes" *by* W. Zhou et al.

W. Zhou et al.

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We would like to thank Anonymous Referee #1 for the thoughtful comments. The following are our responses:

1. In general this is a well written manuscript. However, there are several grammatical and typographical errors which should be addressed in the revised manuscript (for example see the technical corrections below). As such I would encourage a thorough proof reading of the revised manuscript. I feel that the authors have done a good job at addressing the modeling and the ZOC seems a very sensible way of diagnosing the evolution of the PPP. I recommend publication of a revised manuscript taking into account the technical corrections listed below and addressing some of the following points.

Reply: The manuscript has been thoroughly proofread and made more concise where possible.

2. Heterogeneous NOy chemistry: In section3, the model setup is explained and it is stated that the CBM05 chemical mechanism is used. Does this include heterogeneous chemistry of N2O5? I feel that something should be mentioned about the importance of heterogeneous NOy chemistry given some of the important findings from TexAQS regarding NOy chemistry in PPP (Brown et al., 2009). Could this have implications for the simulation of HNO3?

Reply: N2O5 heterogeneous chemistry is typically unimportant during daytime, as confirmed by the low N2O5 concentrations measured (the averaged N2O5 concentration was 0.57 ppt and the N2O5/NOy ratio was 2.5x10ˆ-4) and modeled (the avareged N2O5 concentration was 0.65 ppt and the N2O5/NOy ratio was 5.6x10ˆ-4) during this study. The algorithm for calculating N2O5 hydrolysis is based on the parameterization developed from laboratory data, which is described in Davis et al., (2008).

3. Overestimate of background ozone: The chemistry in the PPP will be influenced, to some extent, by the background oxidants that will mix in. Can the authors comment on the impact of overestimating the background levels of oxidants?

Reply: Ozone is an oxidant and an important precursor of OH radical, playing a key role in atmospheric chemistry and chemical oxidation. Given that no valid OH measurement available and the complexity of sink and source of OH radical beyond the O3-related path, it is unclear whether the overestimate of background ozone will lead to the overestimate of OH radicals.

4. Underestimation of VOC: In section 4.5 it is highlighted that the model fails to capture the concentration of isoprene (simulating the concentrations roughly 50% of the observations). What about other VOCs? Is it possible to diagnose the O3 budget in the PPP to see what reactions are controlling O3 formation and loss and thereby account for the discrepancies between the observed calculated OPE and the modeled.

Reply: Consideration of maximum incremental reactivities shows that isoprene and formaldehyde (a byproduct of isoprene oxidation) were the leading contributors to reactivity. Thus, the comparison of isoprene levels presented in the paper is crucial to understanding modeled and observed reactivity.

Technical corrections:

1. No change for"was" (Line 2 of page 19954)

2. Added "a" to "has relatively" (Line 19 of page 19955)

3. Re-phrased the sentence (Line 21-25 of page 19955). The sentence has been removed.

4. Re-phrased the sentence (Line 7-11 of page 19956). The sentence has been removed.

5. Removed just (Line 8 of page 19958)

6. Removed "the " in ".. used in the processing" (Line 21 of page 19960)

7. Ma-1 to Ma-12 have been added to Fig2. (Line 13 of page 19962)

8. Changed "plume" to "plumes" (Line 23 of page 19963)

9. Replaced "the" with "a". (Line 27 of page 19963)

10. Replaced "their" with "the" (Line 28 of page 19963)

11. Replaced ". . .show the slow . . ." with ". . .showing slow" (Line 21 of page 19964)

12. Removed the first "the" (Line 15 of page 19966)

13. Added brackets around "QC". (Line 22 of page 19966)

14. Removed "the" (Line 14 of page 19968)

15. Replaced "the" with "a". (Line 2 of page 19970)

16. Re-phrased the sentence (Line 3-6 of page 19971). Now it reads: The simulation of the chemistry and transport of PPs by 3-D models are widely used for assessing the effectiveness of emission controls of power plant pollutants. However, the performance of these models has been merely evaluated with ground concentrations (Mauzerall et al., 2005;Vijayaraghavan et al., 2009;Godowitch et al., 2008a;Godowitch et al., 2008b). (Line 3 of page 19971)

17. Removed "the" (Line 26 of page 19971)

18. Removed "the" (Line 4 of page 19972)

19. Re-phrased the sentence (Line 18-22 of page 19973). Now it reads: In this modeling study, the modeled and airborne observed concentrations are compared in detail at each plume transect. Under steady wind meteorological conditions, the fine-scale (4km) CMAQ could accurately simulate the transport and dispersion of PPPs despite lacking a plume-in-grid module.

20. Changed "teh" to "the". (Line 14 of page 19976)

21. Added "a" to "2008". (Line 11 of page 19977)

22. Added "b" to "2008". (Line 15 of page 19977)

23. Removed "a" from "2009a". (Line 26 of page 19979)

24. Fig S9. Caption: changed Panel C local time from 11:50 to 11:30.

Reference:

Brown, S. S., Dubé, W. P., Fuchs, H., Ryerson, T. B., Wollny, A. G., Brock, C. A., Bahreini, R., Middlebrook, A. M., Neuman, J. A., Atlas, E., Roberts, J. M., Osthoff, H. D., Trainer, M., Fehsenfeld, F. C., and Ravishankara, A. R.: Reactive uptake coefficients for N2O5 determined from aircraft measurements during the Second Texas Air Quality Study: Comparison to current model parameterizations, J. Geophys. Res., 114, D00F10, 10.1029/2008jd011679, 2009.

Davis, J. M., Bhave, P. V., and Foley, K. M.: Parameterization of N2O5 reaction probabilities on the surface of particles containing ammonium, sulfate, and nitrate, Atmos. Chem. Phys., 8, 5295-5311, 10.5194/acp-8-5295-2008, 2008.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 19953, 2011.