

Interactive
Comment

Interactive comment on “Mechanisms controlling surface ozone over East Asia: a multiscale study coupling regional and global chemical transport models” by M. Lin et al.

Anonymous Referee #2

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This paper describes regional modeling studies of surface ozone over east Asia and focuses on how boundary conditions, chemistry schemes and model resolution influence comparisons with surface measurements. The study is competent and the results are useful as they highlight weaknesses in our current understanding of tropospheric photochemistry and in our ability to reproduce observed oxidant concentrations. A number of other papers have focused on ozone formation over east Asia (and these papers are acknowledged appropriately in the text), but this study provides further analysis and is therefore a useful addition to the literature. The focus on diurnal variability is one unique aspect of this study that provides a clearer assessment of the reasons for discrepancies between model results and observations.

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Although valuable as a whole, the paper does not provide much additional new insight (in a quantitative sense) into how different processes control ozone over Asia, and I believe that this is a missed opportunity. The paper is strong on description, but weak on more detailed analysis, and the conclusions are therefore less valuable than they could be. What do we learn from the differences between the chemical mechanisms? How important (quantitatively) is the Asian monsoon for suppressing surface ozone in summertime? How might PBL mixing be improved, and would this lead to closer agreement with observations? Additional analysis of any one of these aspects, along with some tightening of the abstract and conclusions, would strengthen the paper considerably.

On balance, I believe that the paper is suitable for publication in ACP, but that it would benefit greatly from some revision, and I provide a number of suggestions for this below. In particular, the abstract and conclusions are vague (e.g., "complex interactions" are referred to but not identified) and these need to be rewritten to sharpen them up and to make it clear what the main contributions of this study are.

Specific Comments

Evaluation of CMAQ performance is covered very well in the paper, but it is not entirely clear how the results may be of use to others. The comparison of CBIV and SAPRC99 remains inconclusive; although there are sometimes large differences between the results, it is not clear why the more simplified CBIV scheme is 'better'. More concrete conclusions on this are required here. Similarly, the focus on diurnal variability would benefit from more quantitative analysis, so that future studies of these variations could be more clearly targeted. Sensitivity studies reducing the nighttime boundary layer mixing height would be particularly valuable here, as they would allow the contributions of mixing depth, titration and deposition to be more clearly distinguished.

In general the paper is well written, but there are inconsistencies in grammar in a number of places that should be cleared up before the final version is submitted.

20247 I.8: It is clear that adjusting the boundary conditions improves model agreement

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in a consistent way. It would be helpful to suggest a reason for this overprediction in MOZART.

20248 I.11: The distributions in Fig 4 are not very informative as they are geographically very similar. It would be more helpful to quantify the burden of O₃ and PAN over the region, and identify whether these differences arise because of the differing production of each species or differing lifetimes. You've started to do this on the next page (20249 I.12), but further detail would provide more insight into the differences between the chemical mechanisms. The differences between the schemes here is worrying: does SAPRC99 overestimate the PAN yield, or does CBIV underestimate it? If you could identify which aspect of the schemes lead to the difference it would go a long way towards resolving the problem.

20249 I.8: I assume that CBIV has a treatment of isoprene oxidation, and if so then the results should be equally sensitive to the estimated emissions? I believe that isoprene treatment has been upgraded in the more recent CB05 mechanism, might this explain some of the differences?

20249 I.17: Glatthor reference: it would be more appropriate to cite an earlier paper for this finding, e.g., Moxim et al. [1996, JGR101, p12621]

20251 I.16: Cloud activity and convective mixing are referred to here without any explanation. How might they contribute to the bias? Monsoon flow (and perhaps biases in photochemistry) are more likely explanations for the summertime overprediction.

20251 I.25: The Wang et al. 2006 measurements focus on outflow from Beijing and direct comparison with MOZAIC data is therefore not appropriate as they are representative of different flow regimes and regions (as outlined in Ding et al. 2008). The following discussion of meteorological differences in August is more relevant.

20253 I.16: The difference in nighttime ozone is also affected by the intensity of NO_x emissions (direct removal of ozone) and by deposition processes. These are both

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influenced by PBL height and mixing, but should be acknowledged here as contributing to the nighttime differences.

20254: The effects of agricultural burning in June are described in more detail in Fu et al. [2007, JGR, D06312], and citation of this paper might replace some of the discussion here.

20255 I.19: It would be useful to make a more quantitative assessment of the effects of resolution here. How much does the RMSE depend on resolution?

20258 I.11: What mixing height would be required to simulate the ozone measurements correctly? This information would be useful to help identify the errors in the current PBL treatment in CMAQ.

20269, Fig 2a: Note in the caption that these figures are for 81 km simulations, and that the adjustments involve reduction in the boundary conditions (i.e., are actually negative).

Minor Points and Typos

20244 I.4: Fig 2a -> Fig 1

20244 I.21: mostly -> almost the (or equivalent)

20245 I.11: 2008b -> 2008a

20248 I.1: remove "while"

20251 I.9: decreasing trend of -> decrease in

20256 I.28: left and right are reversed here.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 20239, 2008.

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