Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-106-RC1, 2018

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Multi-Model Comparison in the Impact of Lateral Boundary Conditions on Simulated Surface Ozone across the United States Using Chemically Inert Tracers" *by* Peng Liu et al.

Anonymous Referee #1

Received and published: 24 April 2018

In "Multi-Model Comparison in the Impact of Lateral Boundary Conditions on Simulated Surface Ozone across the United States Using Chemically Inert Tracers", Liu et al. described the results of lateral-boundary chemically inert tracer implemented in four CTMs with different configurations under the model-intercomparison project AQMEII3, to understand the inter-model differences in the impact of lateral boundary conditions on simulated surface ozone. The method presented in the manuscript is novel and interesting; however, I think the manuscript still needs substantial improvements (especially in writing and presentation) before publication in ACP.

Major comments: The "Results" (Section 3) are not well presented. This section reads

more like a report rather than a research paper. A read may have a hard time finding the major messages (as well stated in the abstract) that the authors wanted to convey, because 1) The content is organized with model pairs, but without clearly stating at the beginning of each subsection what we can learn from the two different setups, which makes the following discussion confusing. 2) The discussions are not focused on the major conclusions (and maybe too lengthy for subsections). Many descriptions and discussions of the minor temporal and spatial features, in my opinion, should be removed or reorganized, especially those cannot be readily explained by current model pairs. 3) The multi-panel color-coded maps are difficult for a reader to follow (especially there are 7 of them) and sometimes misleading (because color scales are different). Since the paper mainly focuses on the difference between mountain west and eastern US, the authors may consider to summarize the results in two regions and present it to the main points of their discussion. 4) Discussions are mostly descriptive and qualitative. Readers may be interested in quantitative estimations of the uncertainties associated with model configurations and physical processes.

I think the authors can greatly improve the paper by rethinking the organization of information and discussion in this section.

Minor comments: Page 7 Line 18-20; Line 31-32: I am not convinced that the higher BC2 (lower BC1) in the mountain west is due to vertical mixing between mid-troposphere and the PBL. More likely, the existence of high mountains can divert the wind in BC1-enriched lower troposphere, so there is less BC1 advected to mountain regions, which is very different from vertical mixing.

Page 7 Line 21: "One possible explanation is that the impact from vertical mixing and the impact from LBCs cancel out in the mountain west region.Âă" Are all these coming from lateral boundary conditions as the authors are analyzing lateral boundary inert tracer? What exactly is the "impact from LBC" here referring to?

Table 1: Do the differences in "gas phase chemistry", "wet deposition for tracers", "im-

pact of sub-grid clouds on radiation", and "impact of sub-grid clouds on ozone photochemistry" affect BC1 and BC2 results? What are the vertical turbulent mixing schemes for different model, which are discussed in the paper?

Figure 10: The authors may consider to move figure 10 to main results. It shows nicely why this study is important.

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