

Interactive comment on “Global O₃-CO Correlations in a Chemistry and Transport Model during July—August: Evaluation with TES Satellite Observations and Sensitivity to Input Meteorological Data and Emissions” by Hyun-Deok Choi et al.

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We thank Dr. Vincent Huijnen for very helpful comments. Our responses are itemized below.

“General comments. This is a very well written manuscript describing a thorough analysis of the model O₃-CO correlations in the free troposphere, as a means to analyze origins of model biases. The authors analyze various meteorological drivers, and the

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relative contribution of different emission sources to the modeled correlations, and evaluate them against TES observations at 618hPa. Overall I have very few comments, hence I recommend this manuscript for publication.”

“Specific comments. In the manuscript I miss a comment regarding the spinup-time of the individual model runs.

Reply – Thanks for pointing this out. Now we state in the text: “All standard and perturbation full-chemistry simulations for July-August as presented in this paper were conducted with a 6-month spinup.” (Section 2.1.1), and “All simulations of radionuclide tracers were conducted with a 5-year spinup in order for 210Pb to reach an equilibrium in the stratosphere.” (Section 2.1.3).

“Also for GMI/fvGCM you use meteorology from the year 1995, while for the other two simulations you take 2005 meteorology. Did you analyze any potential systematic differences between these two years? I understand this has no impact on the general conclusions drawn from this work.”

Reply – We did not examine any potential systematic differences between 1995 and 2005 meteorology. GMI/fvGCM was driven with the output from the fvGCM general circulation model (with sea surface temperature for 1995), which was intended to represent only the contemporary climatological state of the atmosphere. Indeed, this does not affect the general conclusion of this study. We have modified the text (P 9) to: “We drive the GMI CTM with three meteorological datasets from: the free-running NASA Global Modeling and Assimilation Office (GMAO) finite-volume General Circulation Model (fvGCM with sea surface temperature for 1995), the Goddard Earth Observing System Data Assimilation System Version 4 (GEOS4-DAS) for 2005, and the Modern-Era Retrospective Analysis for Research and Applications (MERRA) for 2005.”

“The authors analyze the impact of three meteorological drivers. Here I think it would be very interesting if they would have included, or will include in future work, ECMWF-based meteorology (ERA-Interim) in their analysis.”

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Reply – Indeed, it would be very interesting to include the ERA-Interim meteorology in future work. Now we state in the text (P32-33): “Future work, where additional meteorological archives (e.g., GFDL AM3, ECMWF ERA-Interim) may also be incorporated, should examine the driving factors for O₃-CO correlations in other seasons.”

“The authors blame an over-estimate of O₃ in the SH subtropics in GMI/MERRA due to too shallow tropical deep convection. Even though the contribution of this process is clearly illustrated by the 222Rn-based analysis, I wonder if the conclusion is correct: is there a possibility of compensating errors? Is there independent evidence that MERRA tropical deep convection is too shallow?”

Reply – Point well taken. This overestimate also involves factors other than too shallow tropical deep convection, for which we did not find independent evidence. We have revised the statement in the Conclusion section to: “Among the three GMI simulations, GMI/GEOS4-simulated O₃ concentrations are in best agreement with the observations. GMI/MERRA underestimates O₃ in the NH high-latitude UT due to weak STE, and overestimates O₃ in the SH subtropics. The latter is due to a combination of excessive influences from lightning NO_x emissions and STE (or subsidence), as well as the shallower convection resulting in less low-O₃ air lifted from the LT to MT/UT.”

“The authors also analyze the contribution of STE to tropospheric O₃. Here, it would be useful to see budget numbers of their (annual mean) STE, to be able to intercompare with other systems.”

Reply – Unfortunately, our model analysis focused on July-August and the annual mean STE fluxes of ozone are not available.

“Technical corrections. Pp11, line 10: The tropopause...; Pp17, line 13: ...previously suggested that the O₃ maximum...; Pp19, line 12: ...found a multi-mode l...; Pp29, line 23: ...simulated in downwind ...”

Reply – Corrected.

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