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Evaluation of model-simulated source contributions to tropospheric ozone with aircraft observations in the factor-projected space

C. Shim[1,*], Y. Wang[1], and Y. Yoshida[2,**]
[1]Department of Earth and Atmospheric Sciences, Georgia Institute of Technology, 311 Ferst Drive, Atlanta, GA 30332, USA
[2]Goddard Earth Science & Technology Center, University of Maryland, Baltimore County, Baltimore, MD 21228, USA
[*]now at: Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive Pasadena, CA 91109, USA
[**]now at: Atmospheric Chemistry and Dynamics Branch, NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA

Abstract. Trace gas measurements of TOPSE and TRACE-P experiments and corresponding global GEOS-Chem model simulations are analyzed with the Positive Matrix Factorization (PMF) method for model evaluation purposes. Specially, we evaluate the model simulated contributions to O_3 variability from stratospheric transport, intercontinental transport, and production from urban/industry and biomass burning/biogenic sources. We select a suite of relatively long-lived tracers, including 7 chemicals (O_3, NO_y, PAN, CO, C_3H_8, CH_3Cl, and ^7Be) and 1 dynamic tracer (potential temperature). The largest discrepancy is found in the stratospheric contribution to ^7Be. The model underestimates this contribution by a factor of 2–3, corresponding well to a reduction of ^7Be source by the same magnitude in the default setup of the standard GEOS-Chem model. In contrast, we find that the simulated O_3 contributions from stratospheric transport are in reasonable agreement with those derived from the measurements. However, the springtime increasing trend over North America derived from the measurements are largely underestimated in the model, indicating that the magnitude of simulated stratospheric O_3 source is reasonable but the temporal distribution needs improvement. The simulated O_3 contributions from long-range transport and production from urban/industry and biomass burning/biogenic emissions are also in reasonable agreement with those derived from the measurements, although significant discrepancies are found for some regions.

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