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The zonal structure of tropical O_3 and CO as observed by the Tropospheric Emission Spectrometer in November 2004 – Part 1: Inverse modeling of CO emissions

D. B. A. Jones[1], K. W. Bowman[2], J. A. Logan[3], C. L. Heald[4], J. Liu[1], M. Luo[2], J. Worden[2], and J. Drummond[1]

[1]Department of Physics, University of Toronto, Toronto, Ontario, Canada
[2]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, USA
[3]School of Engineering and Applied Sciences, Harvard University, Cambridge, Massachusetts, USA
[4]Department of Atmospheric Science, Colorado State University, Fort Collins, CO, USA

Abstract. We conduct an inverse modeling analysis of measurements of atmospheric CO from the TES and MOPITT satellite instruments using the GEOS-Chem global chemical transport model to quantify emissions of CO in the tropics in November 2004. We also assess the consistency of the information provided by TES and MOPITT on surface emissions of CO. We focus on the tropics in November 2004, during the biomass burning season, because TES observations of CO and O_3 and MOPITT observations of CO reveal significantly greater abundances of these gases than simulated by the GEOS-Chem model during that period. We find that both datasets suggest substantially greater emissions of CO from sub-equatorial Africa and the Indonesian/Australian region than in the climatological emissions in the model. The a posteriori emissions from sub-equatorial Africa based on TES and MOPITT data were 173 Tg CO/yr and 184 Tg CO/yr, respectively, compared to the a priori of 95 Tg CO/yr. In the Indonesian/Australian region, the a posteriori emissions inferred from TES and MOPITT data were 155 Tg CO/yr and 185 Tg CO/yr, respectively, whereas the a priori was 69 Tg CO/yr. The differences between the a posteriori emission estimates obtained from the two datasets are generally less than 20%. The a posteriori emissions significantly improve the simulated distribution of CO, however, large regional residuals remain, and are likely due to systematic errors in the analysis. Reducing these residuals and improving the accuracy of top-down emission estimates will require better characterization of systematic errors in the observations and the model (chemistry and transport).

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