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Analysis of the impact of biomass burning on atmospheric CO and O3 using observations from the Tropospheric Emission Spectrometer

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Atmospheric CO is a major precursor of tropospheric O3, a harmful air pollutant and an important greenhouse gas. The Tropospheric Emission Spectrometer (TES) on the Aura satellite provides simultaneous vertical profile retrievals of tropospheric CO and O3, offering a unique opportunity to better understand the processes regulating CO and O3. Observations from TES show significantly enhanced concentrations of CO and O3 in the southern hemisphere in November 2004, as compared to simulations from the GEOS-Chem model. Using both a linear inverse modeling and a chemical data assimilation approach, we examine the factors responsible for these high concentrations of CO and O3. The inversion analysis of the CO data suggests enhanced emissions of CO from biomass burning in Australia and Indonesia, compared to the climatological emission inventory in the model. To assess the impact of this biomass burning on the distribution of O3, we conduct forward modeling simulations of O3 using the optimized CO emissions. We also assimilate vertical profiles of CO and O3 from TES in the GEOS-Chem model using a suboptimal Kalman filter. The assimilated CO and O3 distributions are compared with those obtained from the forward model simulations, constrained by the optimized surface emissions, to isolate systematic errors that are not accounted for by the inversion analysis.