5.086 Global CO emissions inferred from assimilation of MOPITT, together with observations of O3, NO2, HNO3, and HCHO..

Early Career Scientist

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Abstract:

Atmospheric carbon monoxide (CO) emissions estimated from inverse modeling analyses exhibit large uncertainties, due, in part, to discrepancies in the tropospheric chemistry in atmospheric models. We attempt to reduce the uncertainties in CO emission estimates by constraining the modeled abundance of ozone (O_3), nitrogen dioxide (NO_2), nitric acid (HNO_3), and formaldehyde (HCHO), which are constituents that play a key role in tropospheric chemistry. Using an updated GEOS-Chem four-dimensional variational (4D-Var) data assimilation system, we estimate CO emissions by assimilating observations of CO from the Measurement of Pollution In the Troposphere (MOPITT), together with observations of O_3 from the Optical Spectrograph and InfraRed Imager System (OSIRIS) and the Infrared Atmospheric Sounding Interferometer (IASI), NO_2 and HCHO from the Ozone Monitoring Instrument (OMI), and HNO_3 from the Microwave Limb Sounder (MLS). Although our focus is on quantifying CO emission estimates, we also infer surface emissions of nitrogen oxides (NOx = NO + NO_2) and isoprene. Our results reveal that this Multiple Species chemical data Assimilation (MSA) produces consistent chemical states that effectively adjust the CO-O_3-OH coupling in the model, which shows the potential of using MSA to produce realistic chemical reanalysis in the future. The inferred CO emission estimates from major anthropogenic, biomass burning and biogenic sources are discussed. The modeled CO is improved by 10-35% over the northern hemisphere through the assimilation,.