Interannual Variability of Carbon Monoxide Emission Estimates Over South America from 2006 to 2010

P.B. Hooghiemstra[1], M.C. Krol[1], T.T.V. Leeuwen[2], G.R.V.D. Werf[2], P.C. Novelli[3], M.N. Deeter[4], I. Aben[5] and T. Röckmann[1]

[1]Institute for Marine and Atmospheric Research, Utrech University, Utrecht, Netherlands; +31-30-253385, E-mail: T.Roeckmann@uu.nl
[2]Faculty of Earth and Life Sciences, Free University of Amsterdam, Amsterdam, The Netherlands
[3]NOAA Earth System Research Laboratory, Boulder, CO 80305
[4]Atmospheric Chemistry Division, National Center for Atmospheric Research, Boulder, CO 80307
[5]Space Research Organization Netherlands, Institute for Space Research, Utrecht, The Netherlands

We present the first inverse modeling study to estimate CO emissions constrained by surface and satellite observations. Our 4D-Var system assimilates NOAA/ESRL Global Monitoring Division surface and Measurements Of Pollution In The Troposphere (MOPITT) satellite observations jointly by fitting a bias correction scheme. This approach leads to the identication of a slight positive bias of maximum 5 ppb in MOPITT column-averaged CO mixing ratios in the remote Southern Hemisphere. The 4D-Var system is used to estimate CO emissions over South America in the period 2006 - 2010 and to analyze the Inter Annual Variability (IAV) of these emissions. We infer robust, high spatial resolution CO emission estimates that show slightly smaller IAV compared to the GFED3.1 prior emissions. Inferred dry season (August and September) biomass burning emission estimates amount to 60, 92, 42, 16 and 88 Tg CO for 2006 to 2010, respectively (see Figure). Comparing the emission estimates with external factors we conclude that climatic conditions (such as the widespread drought in 2010) seem the most likely cause for the inferred IAV in biomass burning CO emissions. However, socio economic factors (such as the growing global demand for soy, beef and sugar cane ethanol) and associated deforestation fires, are also strong drivers of CO emissions but are difficult to link directly to CO emission.

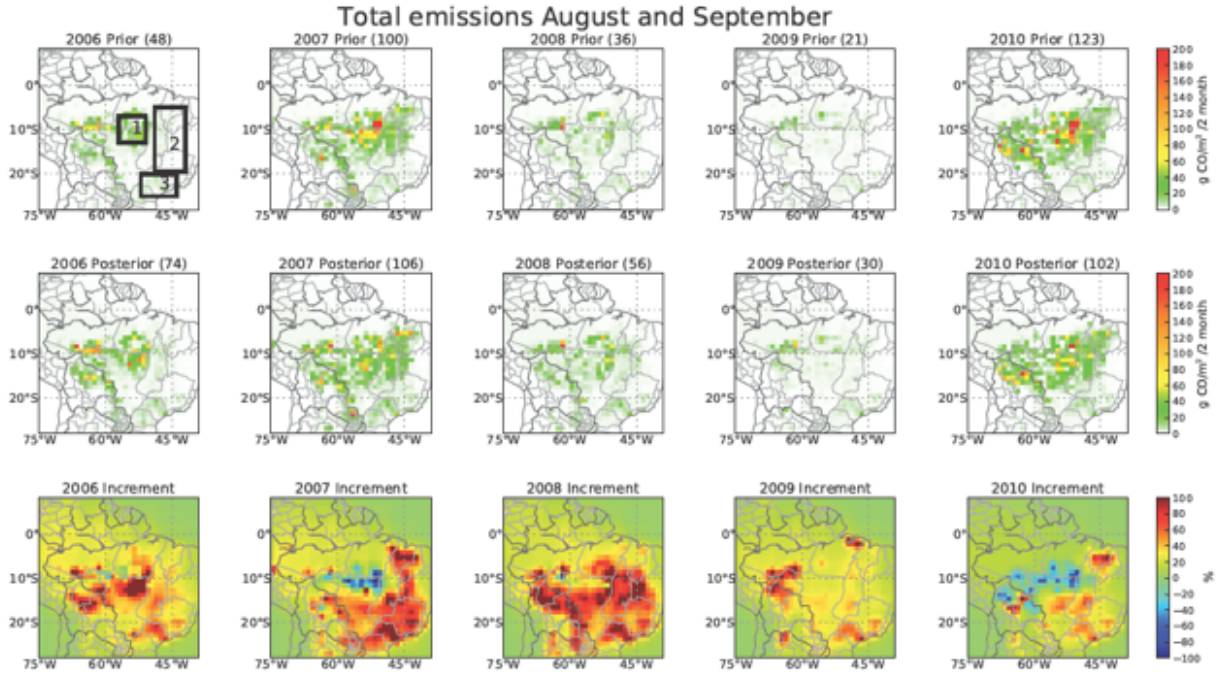

Figure 1. Prior emissions, posterior emissions and increments of the total CO emissions for August and September for the years 2006-2010 in g CO (2 month)/m^2: Numbers in the titles represent the two monthly total emission (Tg CO) for the 1x1 South American zoom region. Biomass burning emissions are derived by subtracting estimates for CO production from NMVOC, and fossil/biofuel CO emissions.