Northern Hemisphere Trends in Carbon Monoxide: Effects of Anthropogenic Emissions and Biomass Burning

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The magnitude and direction of long-term changes of carbon monoxide (CO) in the NH are still debated; although it is most likely that there have been extended periods of increase and decrease, overlaid with much shorter lived changes. The most compelling evidence for a long-term trend results from a comparison of column measurements above the Swiss Alps in the early 1950s and in the mid-1980s. These suggested an linearized increase of ~1% CO yr⁻¹ (1). Measurements above Europe and Russia show increasing abundances in the 1970s and 1980s, after which CO decreased through the mid-1990s (2).

CO has been measured in air samples collected by the Cooperative Air Sampling Network since 1988. The results provide a spatial and temporal picture of CO in the marine boundary layer. Figure 1 shows trends determined for the high and low Northern Hemisphere (HNH, 30°-90°N; LNH, 0°-30°N) and the global mean. The primary sources of NH CO are fossil fuel combustion (FF, 30%), CH₄ oxidation (25%) and biomass burning (BB, 25-35%); its major sink is OH (90%) (3). NH FF emissions of CO have decreased by ~1.6% yr⁻¹ through the 1990s (4). Extreme periods of biomass burning occurred in 1998 and 2002-2003, increasing emissions 50-75% above average (5).

In this paper we examine how changes in FF and BB emissions have impacted CO. The effects of wildfires in 1994, 1998, and 2002-03 are clearly evident in the zonal time series. The background decrease in CO (that calculated without effects of the 1998/2003 fires) is consistent with decreased FF emissions. Rates of decrease in the high latitudes are greatest in winter when the signature of anthropogenic emissions from the extra-tropics is maintained. Year to year variability in CO emissions from BB is large, and extremes in seasonal burning can dramatically enhance zonal CO for a year or more.