Twenty Years Measuring CO in the Troposphere: What Have We Learned and Where Do We Go?

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The GMD Carbon Cycle Group has measured carbon monoxide (CO) in the boundary layer from a globally distributed set of locations for twenty years. CO is an important component in tropospheric chemistry due its high affinity for OH. Prior to ~1994 it was widely held that CO was increasing. Chemistry Transport Models which included increasing CO predicted increases in Methane (CH_4) and other gases destroyed by OH. NOAA measurements in the 1990s were the first to show that CO was decreasing. The observed rates of decline are comparable to results from chemical transport models which include effects of pollution controls on emissions from Europe and the U.S. Vertical profiles, determined from aircraft during 1999-2007, show enhancements in the Northern Hemisphere (NH) free troposphere coincident with surface increases related to wildfires.

The NOAA measurements provide an extensive picture of CO in the lower troposphere and has provided unparalleled insight into its global cycle. Nonetheless, the data contain uncertainties which need review. These are largely related to: 1) The limitations associated with the analytical techniques available before the early 2000s. Methods developed during the past ten years have significantly improved how we measure CO and eliminated previous problems. 2) Uncertainties in the measurements are also due to difficulties producing and maintaining reference gases. Drift in primary and secondary standards at low rates have been difficult to quantify. In this paper we first provide a quick review of what we have learned about CO in the troposphere. We will then discuss the current data set, its limitations and the issues which have been resolved, and lastly, the work still in progress.

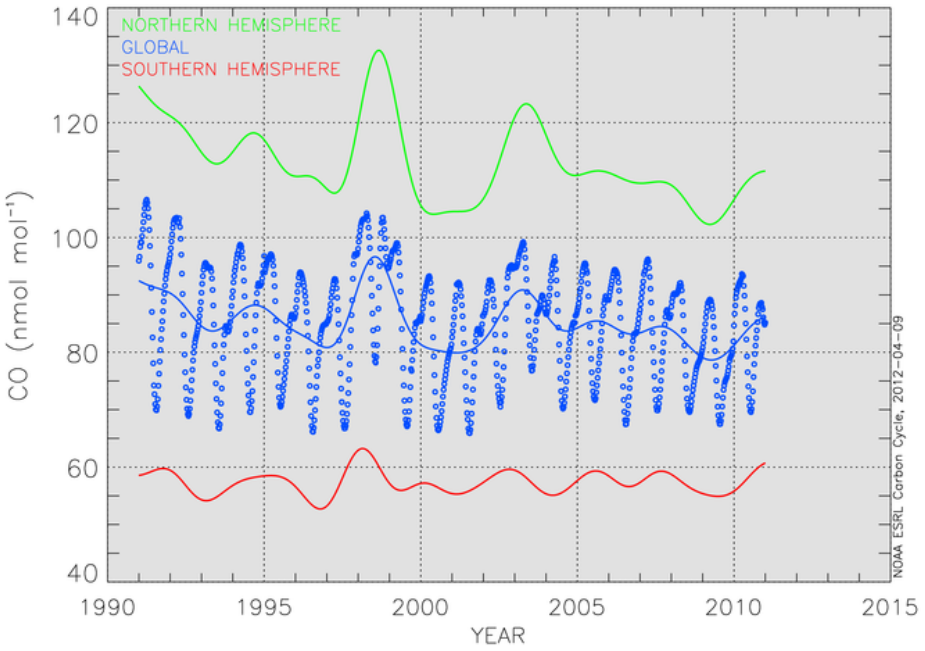

Figure 1. Global, NH and Southern Hemisphere (SH) spatially-averaged time series. Solid lines represent the zonal trends, the globally-averaged CO mole fractions are also shown. The world-wide enhancement seen in 1997-1998 was due to emissions from extensive fires in Indonesian and Boreal Forests. Fires in Russia during 2002-2004 are evident in the global and NH timeseries.