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Interannual variations of the carbon monoxide tropospheric burden between 30 N and 90 N in 1996 - 2003: ground-based and satellite measurements, estimates of biomass burning emissions

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Carbon monoxide total column amounts in the atmosphere were measured in the High Northern Hemisphere (30º-90º N, HNH) between January 1996 and December 2003 using Fourier Transform Infrared high resolution spectrometers installed at the NDSC (Network for Detection of Stratospheric Change) sites. A grating spectrometer of moderate resolution was employed for the same purpose at the Zvenigorod Re-

search Station of the Institute of Atmospheric Physics near Moscow. CO mixing ratios were measured in the air samples obtained at the ground-level stations of the CMDL (Climate Modeling and Diagnostic Laboratory, NOAA) network. Total column CO amounts were measured from space by the Terra/MOPITT instrument between March, 2000, and December, 2003 (Edwards et al., 2004). Anomalies of monthly mean CO densities (related to a quiet period of 2000 - 2001) for different sites in the HNH were in agreement. This fact confirmed a good mixing of CO in the Northern Hemisphere on the montly basis that may be expected from a 1.5-2-month-long CO life-time. The data were integrated over the HNH reservoir (0-10 km in altitude and 30º-90º N in latitude) and the CO burden anomalies (in Tg) were analysed using a box model. Two CO sinks were taken into account: i) internal chemical removal in the reaction between CO and OH, and ii) transport of CO into the southertn part of the Northern hemisphere, where CO concentrations are usually lower. OH concentarations were taken from Spivakovsky et al. (2000). The air exchange through the 30º N boundary of the reservoir was estimated using the GEOS-CHEM model with a real meteorology of 1998 (Yurganov et al., 2004). The interannual variations of the sinks were neglected; a corresponding uncertainty in the retrieved source anomaly was estimated to be 20-30%.

Since 1996 four years have been found to experience high CO emission of similar magnitude (1996, 1998, 2002, and 2003). During four years (1997, 1999, 2000, and 2001) the emissions were relatively low. Seasonal patterns of the emissions in active years were similar, maxima occured in July-August. However, in 2003 emissions in June-July were higher than in August. These semi-hemisphere averaged emission rates correlate with Siberian forest fire counts detected at night time by the ATSR radiometer of the ERS-2 satellite (R^2 =0.51). The early peak of 2003 may be attributed to forest fires in Baikal region, Siberia. An inclusion of fire counts for other areas (Europe, North America) only worsen the correlation; this implies a decisive role of the Siberian fires for polluting the Northern Hemisphere troposphere (cf., Kasischke et al., 2005). It was estimated that the boreal forest fires during active years emit 30-60 Tg CO per month in July-August and 150-200 Tg annually. These emissions may be compared to industrial and transport pollution in the Northern Hemisphere estimated by Kasischke et al. (2005) as 290 Tg CO annually (i.e., 25 Tg monthly).

References.

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