Geophysical Research Abstracts,
Vol. 11, EGU2009-10128, 2009
EGU General Assembly 2009

The time series of carbon monoxide at Zugspitze (2962 m) from 1990 to 2008

H.-E. Scheel

Forschungszentrum Karlsruhe, IMK-IFU, 82467 Garmisch-Partenkirchen, Germany (hans-eckhart.scheel@imk.fzk.de)

Measurements of carbon monoxide have been performed at the alpine site Zugspitze (47 ˚N, 11 ˚E) since 1990. Over the years, different types of instrumentation have been employed, comprising gas chromatography with HgO reduction detector (Trace Analytical RGD2) and non-dispersive infrared absorption instruments with and without gas filter correlation technique (TEI 48S and Horiba APMA-360, respectively). For most of the time, two instruments were operated in parallel. Since 2004, a vacuum UV fluorescence CO analyzer (Aerolaser AL5001) has been in operation as the primary instrument. The CO calibration scale, to which the measurements have been linked, was intercompared within a number of international round-robin experiments.

The CO time series of 1990-2008 was analyzed statistically, in particular with respect to long-term trend and change in seasonal variation. Over the period of 19 years, the annual average mole fractions range between 120 and 148 ppb and display an overall decrease. Linear regression yields a rate of - 0.8 ppb yr^{-1}. A more detailed trend analysis shows remarkable variations. A period of decreasing trend from about 1999 to 2001 was followed by a CO increase until 2004. Thereafter the trend was reversed again resulting in a decrease since then.

Part of the year-to-year variability could be related to periods of enhanced CO emissions due to large-scale forest fires in the northern hemisphere. Particularly noteworthy periods are the second half of 1998 and the time from September 2002 to September 2003, when CO values elevated by about 40 % were observed at several northern hemispheric sites.

High CO mole fractions exceeding 300 ppb, as encountered mainly during winter and spring of the first years of the record, have become less frequent over the years. This is probably related to reductions of CO emissions in Europe. The temporal developments within the upper range of the CO mole fractions are reflected by different statistical parameters. In particular, the comparison of half-hourly values from the mid-1990s with more recent data has indicated significant changes of the data structure. The strong decrease of the high-end mole fractions was substantiated by a trend analysis of the differences between specific percentiles (95^{th}, 75^{th}, and 25^{th}, 5^{th}, respectively).

Within the context of long-range transport, particularly air masses influenced by the upper troposphere and lower stratosphere are of interest. Therefore, the Zugspitze CO data were filtered according to appropriate criteria, using data filters based on thresholds for humidity and the tracer ^{7}Be. The shape of the average seasonal variation resembles that obtained from the unselected data. Both cycles display an April maximum and a broad minimum extending from July to October. However, the filtered CO data have yielded lower mole fractions of the cycle, with differences of 34 ppb for April and 9 ppb for July (1990-2004 average). A trend estimate based on the same data sets has resulted in a small positive trend of 0.5 ppb yr^{-1}, in contrast to the negative rate of - 0.5 ppb yr^{-1} calculated from the unfiltered data for the same period. This is indicative of different developments of the CO emissions on regional, continental, and hemispheric scales.