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The long-term (1996-2010) London record of carbon monoxide and molecular hydrogen: evidence for improved air quality

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The long-term record of CO at Royal Holloway shows significant decline from 1996 to 2010, especially in the years 1996-2003. The annual mean CO mixing ratio is now a third of the value for 1996-1997. As CO is a broad proxy of many gases contributing to air pollution, these results suggest substantially improved air quality since 1996, probably largely as a result of stronger measures to control vehicle emissions.

Atmospheric Carbon Monoxide and Hydrogen have been measured quasi-continuously (30 min interval) at Royal Holloway, on a hillside 30km WSW of central London. Since Sept. 1996, measurement has been by a Trace Analytical Reduction Gas Detector (RGD-2). From July 2007, the same air has been measured at 5 minute intervals by a Peak Performer I (RCP detector) using $2^1/_8$ packed columns in series, Unibeads 1S and Molecular Sieve 5A. CO is calibrated fortnightly against NOAA standards (range 150-300 ppb). Intercomparison with other EU labs has shown the Trace Analytical RGD-2 instrument (pre-July 2007 data) to be non-linear at high CO values (i.e. in polluted air) possibly overestimating extreme events ($>$1000ppb) by as much as 30%. From 2006, H_2 has been calibrated monthly against internal standards (526-799 ppb H_2) as measured at MPI-Jena in *Eurohydros*. A target gas is measured daily.

The Egham site frequently experiences near-background Atlantic air, and during strong south-westerly airflow, CO and H_2 mixing ratios at Egham are closely similar to contemporary Atlantic air flasks collected at Mace Head in Ireland and measured in our lab on the same instruments. In contrast, urban air masses are very different. During long-lived anticyclonic events, especially near dawn when the inversion is low, air stagnates and pollution builds. In the late 1990s, peaks ranged as high as circa 11 ppm CO - such levels are not now reached.

Peaks in H_2 and CO mixing ratio occur around the times of the morning and early evening rush hours and are thought to be predominantly from vehicles and boiler/heating emissions. Both H_2 and CO mixing ratios usually decrease overnight due to soil uptake, reaching a minimum at around 0500. The dry deposition rate of H_2 calculated during anticyclonic conditions in 2008 was 0.05 ± 0.03cm s^{-1}.

CO has shown a downward trend throughout the measurement period but particularly since 1999. This trend may be partly illusory, given the relative infrequency of major anticyclonic pollution events since 2000, in contrast to the numerous such events in the late 1990s. Nevertheless, the overall trend is convincing: CO is much reduced.